

The Nature of Flatness

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Book One: Reflection

Chapter One: Understanding Flatness

Introduction

Architects are constantly challenged to think three-dimensionally. They ruminate on issues of volume and void, tectonics, and movement through space. On the surface, flatness appears to have little presence in this discussion. It may appear as a building component such as a wall or floor, but it is not thought of as a driving factor in design. In reality, it is precisely that. The idea of flatness not only has a considerable impact on architecture, it is intrinsic to it. Examining flatness reveals much about how we observe and comprehend space.

Examining the meaning of the word flat in the context of architecture is a complex task. A purely verbal definition is meaningless without holding it up to corresponding physical examples. Flatness is only one of many variables in an architectural design, so it is difficult to isolate and analyze flatness in architecture. Inquiry into flatness must tease out the essence of the word using multiple tactics.

In this project, three methods will be combined to generate a clear architectural understanding of flatness. The first part will be a reflection upon the existing definition and related terms. Second, a collection of architectural precedents will be arranged and examined to discover specific characteristics of various types of flatness. Third, those characteristics will be isolated and examined further by conducting simple and specific 'experiments.' This combination of reflection and action will then provide the basis for an installation piece which will encapsulate conclusions about the nature of flatness.

Flatness: relation to architecture and space

Flatness is an essential feature of two aspects of architecture. First, it is an important characteristic of design media - specifically, the page and the computer screen. Second, the interpretation of flatness within spatial conditions has been an essential reflection of design practice. In both drawn and built architecture flatness is a key ingredient, the exact properties of which are often elusive.

The blank page is the most striking example of a flat medium upon which architects design. It leads to perceptibly flattened representations of space (plan, section, elevation). Perspectival and axonometric drawings provide an impression of space from a particular viewpoint, suggesting depth where there is none. Plans and sections make incisions along imagined planes to resolve or reveal organizational information. There are countless possible configurations of proposed space within that single plane of the page.

In the context of drawing, the flat condition's fundamental neutrality has offered endless possibilities. Today, the architect has access to more inventive and dexterous fabrication methods, and more complex communication media than ever before. Paper is now complemented by the flat screen. Computerized fabrication and digital design programs have begun to narrow the gap between what is drawn and the built product. Digital media permits the implementation of design methods that were previously too geometrically cumbersome to easily produce. A drawn shape can be adjusted by manipulating numeric variables rather than drawing and erasing lines on paper as architects have historically done. For this reason, it is important to reconsider what 'flat' is to position it within architectural design.

Flat components are part of a spatial vocabulary from which architects assemble specific and unique spaces. Some architects celebrate stark, flat surfaces while

others camouflage them with textural, ornamental, or other treatments. What is done aesthetically with these elements and how they figure into architectural design depends on the intent of the architect. The impact of these decisions relies upon observing and contemplating them in the built product. Flatness in architecture has meaning because of how it is perceived and conceived.

The role of flatness in built architecture is quite different from its role in design drawings. Flatness is inseparable from the perception and understanding of space from the perspective of the body. Whereas someone looking at a drawing may imagine themselves walking around in the drawn space, this is purely a mental exercise. Standing in space, the body perceives the physical qualities of flatness by examining how it appears and feels.

Flatness exists only as an attribute which is observed and described. Without the figure, flatness is irrelevant; it relies on perception. For example, a calm pond is simply a body of water held in place by natural forces. It is not innately flat, but rather imbued with flatness by the figure. The pond is seen from the bank, its surface is observed, and thought of as flat. Without viewpoint and cognition, the pond simply is.

The definition of 'flat' is not complete without situating it in relation to spatial concepts such as height, depth, and the horizontal. The meaning of flatness must adapt to changing ideas about the nature of space. Flatness is similarly affected by the methods for measuring and mapping space. This change is reflected in how flatness is used in architectural precedents.

The Definition of 'Flat'

The following are several definitions of 'flat' as found in the *New Oxford American Dictionary*:

- "1. smooth and even; without marked lumps or indentations : a flat wall ...*
 - (of land) without hills ...*
 - (of an expanse of water) calm and without waves.*
 - not sloping ...*
 - having a broad level surface but little height or depth; shallow ...*
- 2. lacking interest or emotion; dull and lifeless ...*
- 3. (of a fee, wage, or price) the same in all cases, not varying with changed conditions or in particular cases ...*
- 4. (of musical sound) below true or normal pitch ..."¹*

Three necessary concepts stand out in this definition. First, the flat is associated with level ground and the horizontal. Second, flatness is intrinsically linked to surface. Third, the spatiality of flatness approaches, or is equal to, a plane. This is not to say that horizontal, surface, plane, and flat are interchangeable. The relationships of these concepts are necessary to clarify the nature of flatness.

While these spatial qualities are mentioned in the definition, there is an interesting theme of differentiation in the choice of words. The word 'without' appears several times, and is accompanied by 'lacking' and 'little.' Flat is repeatedly defined by what is absent from it, or by what it is not. In actuality, the definition is describing what a flat thing would be if some aspect of it was not missing. It does not pinpoint possible qualities of flatness beyond descriptors such as 'even.'

¹ New Oxford American Dictionary.

The dictionary leaves flatness wide open for discussion. What comes before and after flatness? How does flatness arise? How can one measure how flat something is? What potential arises from flatness? What are the specific spatial qualities created by a flat condition?

Careful observation is necessary to fill in these blanks left by the dictionary, and to reveal the part flatness plays in architectural design. However, the concepts that are explicitly linked to flatness must first be examined as entry points to the discussion of flatness. Like flatness, they are attributes which are perceived by the body in space. Once the terms have been investigated, they can help to glean meaning from phenomenological observations of flatness.

Related Terms: horizontal, plane, surface

To more clearly comprehend the dictionary definition of flatness, it must be understood in relation to the horizontal, the planar and the surface. While each term is included in the definition, the appearance of these attributes is not equivocal to flatness. By examining their meanings, it is possible to discern precisely how they coincide with flatness.

Horizontal: *“parallel to the plane of the horizon; at right angles to the vertical”*²

The horizontal, or “not sloping” aspect of flatness speaks to its relationship with the position of the body. It can be seen, but also measured by standing, sitting, or lying on it. Horizontality is described with relation to, or as part of, the ground. Its presence or absence can be observed by balancing on it, measuring its evenness just by standing, sitting, or lying on it. By extension, horizontality is linked to the scale of the body. If it is large enough to be considered in relation to the ground, be it by touch or sight, then it may be described as horizontal or not.

Plane: *“a flat surface on which a straight line joining any two points on it would wholly lie: the horizontal plane.*

- *an imaginary surface through or joining material objects...*
- *a flat or level surface of a material object*³

A plane is flat to an extreme in the sense that it is a two-dimensional field. This flatness is described in terms of Cartesian coordinates, where only X and Y of XYZ have nonzero values. In theoretical space, a plane has only two dimensions. In real three-dimensional space that condition is an impossibility,

² *Ibid.*

³ *Ibid.*

and its meaning approximates the theoretical plane. In those circumstances, something flat, smooth, and very thin might be thought of as planar. It may also describe the smoothness and flatness of a surface. Alternatively, the term could be used to describe an imagined plane in space, perhaps implied by the alignment or orientation of a set of objects.

Surface: “the outside or uppermost part of something (often used when describing its texture, form, or extent) ...

- *the level top of something ...*
- *(also **surface area**) the area of such an outer part or uppermost layer ...”⁴*

Surfaces, however, are not necessarily thought of as flat. An object’s surface might be characterized in a multitude of ways, such as round, long, bulbous, jagged, and so forth. However, if the surface of an object is defined as “the outside part or uppermost layer of something”, then even if the object itself is not flat, the surface as an epidermal layer shares a quality with a plane.

One might argue that a surface that isn’t rectilinear cannot be flat and therefore is not like a plane. However, consider the surface of a sphere. Imagine that the surface was used as a reference frame instead of XY. Whereas Cartesian space described as XYZ is thought of orthogonally and has only one possible Z axis, the surface of a sphere has an infinite number of diverging Z axes. Analogously to a plane, the reference surface, still has a value substantially greater than the values of its Z axes, and is therefore flat. Put simply, the way space is understood is contextual, with respect to Cartesian space, to the Earth, or to some other cardinal reference.

⁴ *Ibid.*

To Flatten: flatness as action

Flatten: “make or become flat or flatter”⁵

In architecture, the idea of ‘flattening’ is also necessary to flatness. Since the design process occurs in both the non-flat and the flat (e.g. ideated, drawn, and built), it is also important to clarify what it is to flatten. In the strictest sense, to flatten is to make flat or flatter. It means causing something to have qualities intrinsic to flatness, such as textural flatness. The ‘flattening’ requires a force or agent of change. Thinking within Cartesian space, this force would generally act along a single axis, decreasing the depth or thickness of a thing to increase the flatness of its surface or surfaces. In a textural sense, to flatten could mean to make an uneven surface level and smooth.

Because of the necessity for graphic media in architecture, flattening must be thought of in a slightly different way. Flattening is not just a smoothing or compressing force, but also a complex process of showing space that doesn’t exist in drawing media, be it on paper or screen.

In the design process, a flattening force is analogous to, but less simple and transparent than the physical flattening of an object. The complexity of graphically flattening a thing or idea opens the process to many variables, and necessitates editorial choices. In other words, the architect envisions a proposed space as having height, width, depth, and existing through time. However this four-dimensional configuration is not immediately made. It is articulated as plan, section, elevation, perspective, axonometric, and other types of drawings. The ideas and relationships in the envisioned space are abstracted and simplified to a degree as they are translated to a flat medium. This flattened representation of the envisioned enables clarity and simplification of complex ideas by selecting

⁵ *Ibid.*

how and where pieces of information will be represented. In this case, flattening is an intermediate step in design.

Each type of drawing serves a particular purpose. The surface of the page acts as the interface of a single viewpoint and the information visible from that point. In the case of a section or axonometric drawing, the viewpoint is theoretical. A perspective drawing aims to emulate the appearance of a space from a particular viewpoint.

Even in the case of three-dimensional computer modeling, this flattening occurs. A fly-by animation can suggest four-dimensionality, but still exists on a flat screen. Although there are key differences between the flattening to the page and the screen, they still have in common the simplified representation and abstraction of complex four-dimensional ideas.

Using the term ‘to flatten’ in the sense of putting architectural space to paper implies that the process of selecting and applying key elements to flat media is not limited to architectural drawing. The same abstractive process is arguably involved in creating diagrams and text. The architect creates a building plan. It shows the scale and position of a series of rooms as seen from above. The degree of detail (e.g. texture, material), the boundaries of the space (e.g. the outer walls, the building site) are all points of editing out superfluous information to clarify the idea behind the drawing.

Similarly, a lexicographer writes the definition of a word to give the reader a clear idea of its meaning. This process requires a degree of craft. The definition’s purpose is not to explain the word’s meaning in every possible application, but rather to succinctly describe its essential character. Just as the building is not equal to the drawing set, a word is not the same thing as its definition. Here, the ideas are selectively flattened to signify their essential parts.

The Flat Condition as Interface

Interface:

- “1. a point where two systems, subjects, organizations, etc., meet and interact...*
- 2. a surface forming a common boundary between two portions of matter or space.”⁶*

When considered as an area of interface, the flat is the site of meeting points or events in both physical and graphic conditions. Interface describes the behavior or context of surfaces. Rather than the physical attributes of a surface, it indicates that some event, change, interaction, or transition occurs.

In a graphic context, several such interactions occur at the interface of the page. Two exist as a design is drawn, and the third manifests when the drawing is viewed.

The first interface condition appears when an architectural idea develops as it is drawn on the flat page or screen. The page is where the idea becomes visible, as well as being the medium from which the built product is measured and laid out. The type of drawing produced and the limitations of the page affect the way the design develops. As an architect draws a design, mental images become refined and resolved. This is affected by the type of drawing made, be it a conceptual diagram, plan, or otherwise. When completed and combined, these drawings constitute something with more clarity and specificity than the original idea.

The condition of interface in architectural drawings also provides insight into the architect's understanding of space. The potential and constraints of the page

⁶ *Ibid.*

cause the graphic vocabulary of drawing (e.g. point, line, plane). This in turn informs the manner in which ideas about space are represented. To propose or depict new spatial conditions, the architect implicitly includes his or her perception and conception of space as a factor when representing a design on flat media.

Consider the axonometric drawing as a particularly revealing example of this. As a representation of space, it communicates a great deal about how an architect perceives space. This is because it typically relies on a Cartesian understanding of space, in which there is a point of origin and three perpendicular axes from which everything is measured (an invisible grid). These axes are flattened onto paper by showing them as non-perpendicular angles, exposing more of the object than regular perspective. In this scenario, time as a dimension is also typically absent, as it is in many conventional drawing methods. The building is depicted as static.

Third, the graphic abstraction of space is useful to architects because it creates a juncture for two conditions. It lays out ideas to interface with the human eye. Drawings act as portals into a proposed design visualization. Through each portal, one has a view of particular elements from a certain position. Individually, they don't show the entire design, but together they can create an impression of the whole. The drawing is essentially an intermediate step between the architect's mind and others, during which the design is flattened for ease of communication.

Flatness as an architectural condition is significant because a flat surface causes and defines an interaction between two elements, and therefore becomes charged with the physicality and meaning of their juxtaposition. The interfacing elements and their configuration determine the actions of the particular flat

condition they create. In physical form, flatness is the boundary condition where volume, void, and surface meet and interact.

The boundary at an interface might be static or changing. The condition could be infinitesimally thin, or perhaps thickened - consciously pulled apart to develop complex relationships within a transitional layer. Changing the attributes of an interface such as this could turn a liminal or surface condition into something with depth, layers, complexity, and more importantly, space. The flat's deceptive simplicity peels away to reveal the ambiguity of flatness, and its unexpected depth.

Summary: the expanded definition

Reexamining the meaning of flatness and its associated concepts reveals an unexpected depth beneath the surface of the definition. The flat unfurls to reveal a myriad of architectural configurations. Further analysis reveals only underlying layers, new convolutions of meaning, and billowing complexity. Positioning examples of flatness in relation to other related terms reveals that there are many different kinds of flat conditions.

The meanings of 'flat' and terms relating to flatness can be applied as a meter to organize examples of flatness into types. These types could then be analyzed for unidentified themes or concepts which could then be used to complete the definition of flatness. In order for us to understand flatness in more practical terms, our analysis must therefore be supplemented by observation and study of precedents, and by controlled experiments.

Chapter Two: Method

The Project

Flatness will be framed by the architectural definition, but explored using pure observation. Existing architectural precedents and thoughtfully conceived exercises will be the source of these observations, and each part will inform the other organically.

The examination of architectural precedents is intended to clarify ambiguity in the definition of flatness, as well as organize its diverse examples. Themes that arise in the definition (i.e. smoothness, interface) will act as a grid with which to organize examples of architectural flatness. The purpose of this exercise is not to find logical progressions amongst these precedents, but rather to articulate and clarify any observed themes and use them to expand the existing definition of flatness. The result will be a taxonomy, or typification of treatments or uses of flatness in architecture, with the secondary outcome being a vocabulary for naming and describing types of flatness that are relevant to architecture. This vocabulary will also be used to inform the design of exercises to follow.

The taxonomy can show existing applications of flatness in architecture. However, highlighting specific aspects of flatness is difficult to achieve using only existing precedents, since they are complex. For this reason, experimentation and phenomenological observation are necessary to understanding the potential and mutability of the flat. Whereas a building precedent is an intricate object from which to isolate flatness, a carefully controlled experiment can reveal a single, simple quality of flatness and its potential to affect different designs. For these exercises or experiments to be successful, they must be precisely and unambiguously described, and the resulting observations must refer to the process, not just the outcome. Therefore, each experiment must be carefully

controlled, having only one variable (an external force or agent) acting upon the selected object. In addition, it should be observed and discussed as a phenomenon of flatness. The experiments will be conducted as a first and second set, so that results from the first set can be further explored in the second.

Flatness is a condition that evolves into more complex conditions which are constrained (compressed, condensed, etc.) by that original condition. The goal of the exercises to follow is to prove and elaborate upon this fact. In designing each exercise, the objective is therefore to discover some aspect of this phenomenon.

The assembled findings of the experiments are to be further investigated as a final installation piece. This piece will encapsulate prevalent themes from the taxonomy and experiments. It will aid in refining the complete definition of flatness.

The project findings are to include a refined categorization of flatness, insightful findings through controlled experimentation, an unambiguous, functional, architectural definition of flatness, and insight into possible future interpretations of this working definition.

Book Two: Analysis

Chapter One: Taxonomy

Introduction

Various themes arise from the task of defining flatness in the context of architecture. These themes are reflected in the seven categories identified as definitive in this taxonomy. The purpose of the taxonomy is to illuminate and clarify flatness in relation to specific observed attributes. Along with helping define flatness, the second aim of identifying precedents is to have them as archetypes, a source for ideas in devising other exercises in this project.

The precedents are mostly architectural, but because of the importance of graphics both to architecture and flatness, some examples are borrowed from related fields such as photography and animation.

The following are seven types of flatness:

- Terrestrial
- Planar
- Material
- Surface
- Layered
- Topological
- Representational

These types overlap to a certain extent because pure precedents may be rare. However, each precedent is chosen for a dominant feature which typifies its grouping. The taxonomy is not intended to imply a timeline or causality between

the different precedents. Scrutiny of the architectural precedents are intended to reveal more about flatness. Is it an original or end condition in architecture. How and why does it appear? What effects or conditions arise from it in differing contexts?

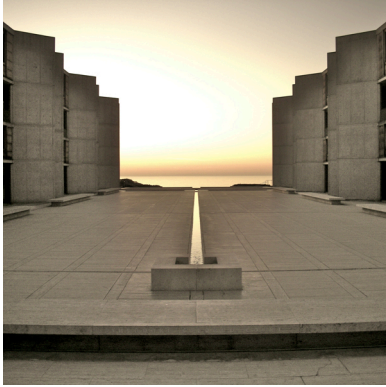
Terrestrial:

“of, on, or relating to the earth...

• of or on dry land”⁷

Terrestrial flatness refers to the characteristic of being aligned with or parallel to the ground. Examples possess a dominant horizontally flat element, or a reinvention of that horizontality. Examples of terrestrial flatness engage the ground or earth. They are observed using both sight and balance of the body.

⁷ New Oxford American Dictionary.



The Salk Institute
by Louis Kahn

The Salk Institute is a strongly ordered pair of parallel laboratories framing a paved court which is parenthesized by the ocean at one end and a stand of trees at the other. The buildings run along the main axis of the court, closing off to the surrounding landscape. The same axis is articulated by a narrow pool which originates near the trees and terminates in a pool at the ocean end of the space.

The court's terrestrial element combined with the fabricated streamlet are what negotiate the transition of landscape to seascape on this coastal site. The laboratories obscure most of the surroundings, leaving the terrestrial exposed at one end, and the oceanic at the other. The proportion and orientation of the pool draw the eye toward the horizon, directing the eye beyond the boundaries of the built site and out to the ocean. The trees at the other end interrupt this horizontality, creating a conundrum - although the court is terrestrially flat, its smoothness is more similar in appearance to the water than the actual terrain.



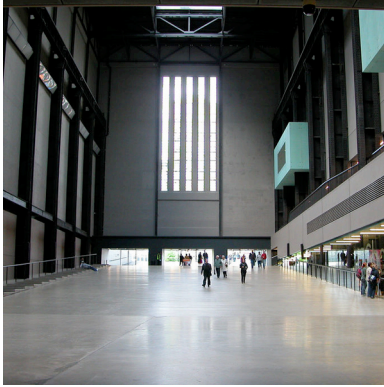
Berlin Holocaust Memorial

by Peter Eisenman

This intervention into a flat urban site consists of fragmented flat or very gradually sloping elements. The design suggests a splitting action of the ground's surface into higher and lower elements, as if a grid of rectangles were extruded from the original surface, while the remaining paths were squeezed downward at one end of the site, creating a gradually increasing differential along an invisible axis.

The split and fragmented surface suggests weight and volume, contributing new depth to the original flat condition. In doing so, it draws attention to the interface of air and ground as one of void and substantial volume, rather than simply a thin visible surface. This precedent suggests an original state of flatness that has been thickened and fractured. Flatness is implied as the intervened condition.

The body is enveloped into this ambiguous layer between earth and air. As a result, it dwells below a typical relationship with the terrain. Rather than touching the ground with one's feet, the body is funneled into a fractured layer of surface.



Tate Modern Turbine Hall

by Sir Giles Gilbert Scott

renovated by Herzog and de Meuron

The turbine hall at the Tate Modern is a large room with a polished concrete floor, part of which is sloped upwards through the entrance and a length beyond. The ramp segment of the floor has a shallow, broad staircase to one side, and a smaller, railed ramp on the other. Apart from the ramp, most of the elements in the room are orthogonal.

The ramp is unusually large, and its scale draws attention to the act of traversing it. Whereas ramps are typically strictly for circulation, this ramp is not explicitly so, except for its railed and stepped edges. Instead, it creates an ambiguous part of the room, both in keeping with the scale of the space as a whole, and bearing the singular difference of the angled floor.

The body is both entering through circulation and simultaneously in the midst of the destination. The primary reminder that the ramp stands out is that the body is forced to balance on a surface which is slightly askew.

Analysis:

In the three cases of terrestrial flatness described, there was the common thread of repositioning or reorienting the body using the ground. At the Salk Institute, the position of the body is described in relation to the coast, at the meeting point of ground, sky, and sea. In the Holocaust Memorial, the body is re-situated in relation to an original condition of flat ground. At the Tate Modern turbine hall, the body is placed in a gradual and exaggerated entrance condition, creating ambiguity between journey and arrival.

Planar:

“of, relating to, or in the form of a plane”⁸

Planar flatness denotes having a thin, flat part or parts. The thinness of the plane connotes two-dimensionality, and by extension, dematerialization. It is associated with immateriality, transparency, skin, and geometry. In architecture, a plane may also relate to the reduction of components to their simplest possible shape.

⁸ New Oxford American Dictionary.



Barcelona Pavilion

by Ludwig Mies van der Rohe

The Barcelona Pavilion consists of intersecting planes of varied material, orientation, scale, and texture. These planes are responsible for the openness of the structure as a whole, and its relation to the outdoors. The roof is cantilevered outwards and its edges don't simply terminate where they intersect. Instead, the meeting point of inside and outside is difficult to distinguish, and the interior is alternately sheltered and exposed.



Moreover, the planar pieces are architectural components (wall, floor, roof, etc.) that have been stripped down to elemental parts. The beams are hidden, flattening the planes further and exaggerating the effect. The planes aren't recognized as floor or window, but become the points of transition between specific spatial conditions where they intersect or terminate.

The marble wall shown here is planar in that it suggests a two-dimensional geometry. In addition, the material itself suggests thinness because it consists of book-matched slices that speak of their origin in a solid volume. The smoothness of the flat surface brings out this quality.



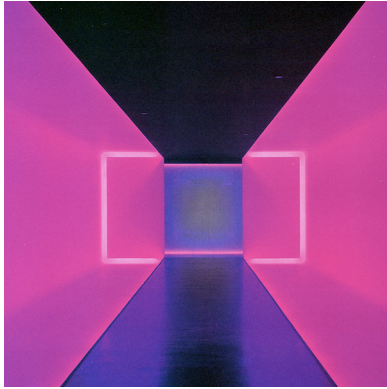
Dom-ino House

by Le Corbusier

The planar components in this ideational diagram are the concrete slabs and the floating staircases. The reduction of a house to this simple module is intended to standardize and simplify the home. Here, the planes are the essential components. Anything else which is added serves to specialize the building's function. The slabs and grid are neutral constants in any variant of the Dom-ino House Design. All other components can be tailored to suit living needs.

The slabs are the flat component of this three-dimensional *tabula rasa*, and they offer possibility, just as a sheet of blank paper does for drawing. In the drawing, the beams have been erased, making the scheme more compelling as an idea about space and construction. The elementary parts of the structure are depicted as though they have been flattened to produce the minimum configuration.

As a drawing, the Dom-ino House diagram is quite starkly flattened, consisting only of lines and planes which produce simple, orthogonal shapes.



The Light Inside

by James Turrell

This installation is flat in the sense of arranging planar parts, and in using colored light to distort perspective. The planar elements of *The Light Inside* work as a system that is intended to reorient the body and the eye in space. The lighting casts an evenness in texture throughout, and combined with the geometry of the space, suggests a sort of forced perspective that suggests an overall flattening of the room.

The planar elements here, (the floor, walls, ceiling) work to produce particular effects. The floor is of note within this spatial condition because it is similar to the ceiling in its darkness, but contrasts in texture. In contrast, the ceiling absorbs the light and dematerializes, suggesting void. The floor is dark but reflective, implying an inaccessible, mirrored space below its surface. Like the ceiling, the walls convey solidity. Their relationship to the floor disorients further. The complex configuration of planes combines with the surfaces' different relationships to light (i.e. reflective, flatly lit, dark) to disorient the eye.

Analysis:

Each of the planar precedents consisted of simple, elemental parts which were configured to create a certain effect. The Barcelona Pavilion consists of asymmetrically intersecting planes which combine to create uncertain or implied boundaries between spaces, or interior and exterior. Since the elements read as planes, rather than floor wall, etc., they also create ambiguity between the different components of a building.

The Dom-ino House is similarly elemental, but designed to create neutrality and flexibility within a standardized structure. The flatness of The Light Inside presents the eye with a confusing configuration of space using lighting and material effects. The effect is one of uncertainty.

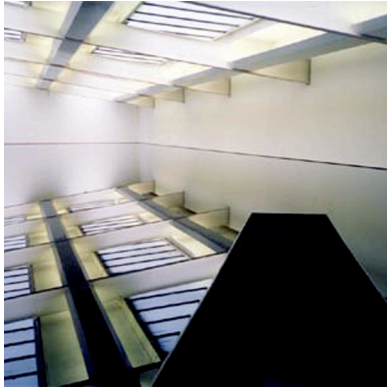
Each case relates to simplification or reduction of parts into elements. The plane quality of these elements gives clarity to their intended message or effect.

Material:

“the matter from which a thing is or can be made”⁹

Material flatness means smoothness of surface, and relates to the reflectivity or transparency of that surface. The texture of the surface, and not its shape, which is the key quality. In the examples, the material quality of the flat component is instrumental in producing a particular effect.

⁹ New Oxford American Dictionary.

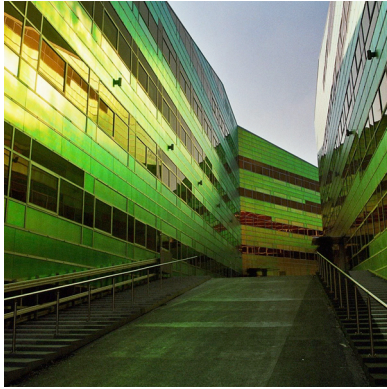


20:50

by Richard Wilson

This architectural installation consists of a narrow path carved out of a basin of oil that fills the entire bottom half of a room. The oil is smooth and perfectly reflective, such that where considerable mass exists, one sees void. The textural quality of the surface confuses the viewer as their eyes work to determine where the actual boundaries of the room are. The oil simultaneously hides itself and reflects light coming from the room, and the impact of this effect relies on an extremely smooth flat surface.

The highly reflective surface of the crude oil contradicts its actual properties. The oil is extremely dense, heavy, viscous, and typically thought of as dark. However, the surface reads as void until it is more closely examined.

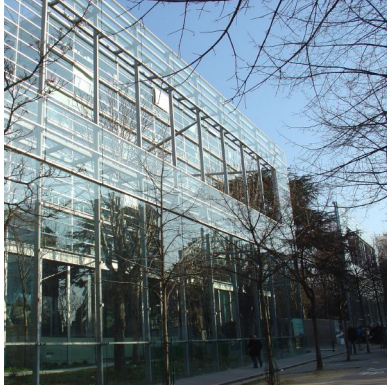


Almere La Defense

by UN Studio

The courtyard space of this building is wrapped with a highly reflective, multicolor foil which changes its hue as it is viewed from different angles. The foil spans the walls in stripes, alternating with reflective windows which then bounce back patterns on other nearby walls. The reflective patterns vary with the time of day. The angle of the sun bounces light off the surfaces to colored patches on the ground.

Through a choice of material applied to the flat surfaces, flat exterior walls become the source of a dynamic, vibrantly hued sensory experience. The foil placed in this context is the most unusual feature of this space. It is a static, flat material but appears to be animated because of the way it refracts light. The foil's flatness affects the light patterns it creates, in contrast to the reflections a wrinkled film would produce. However, the key trait is the refraction of light, which transforms the building's flat surface into hypersurface by allowing them the change in appearance through time and projecting light beyond the surface.



Fondation Cartier
by Jean Nouvel



Nouvel intended for this contemporary museum to create ambiguity at the interface of interior and exterior space. The enclosed volume on the building is obscured by a flat facade that extends beyond its boundaries. The building is also camouflaged by its transparency. Alternately transparent and reflective, the glass exterior dematerializes the built volume, and erodes its substantial mass.

As with the other material precedents thus far, the effect created by Nouvel's facade depends upon materiality, noting transparency and reflectivity in particular. However, the distinction is that the optical effect does not occur only on the building surface. The idea of reflectivity and obfuscation carries through the whole building tectonic as well as the site, creating plays on interior and exterior, solid and transparent.

Analysis:

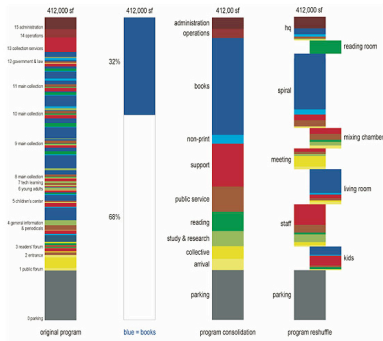
The effects created by this type of flatness are at least as numerous as the material possibilities. The planar surfaces (the outermost flat layer) or actual planar components (particularly glass) are the essential elements because they determine texture, color, transparency, opacity, and reflectivity. In these cases, the glass and reflective surfaces produce effects that extend beyond their dimensions through the behavior of light.

Surface:

“the outside part or uppermost layer of something (often used when describing its texture, form, or extent)”¹⁰

Surface flatness describes applied or altered graphic or decorative treatments of a flat surface. It relates to programmatic factors, the dialectic interface of two elements, and/or skin. In non-static cases, slipperiness and ephemerality are additional attributes, especially with the presence of a screen.

¹⁰ New Oxford American Dictionary.



Seattle Public Library
by OMA

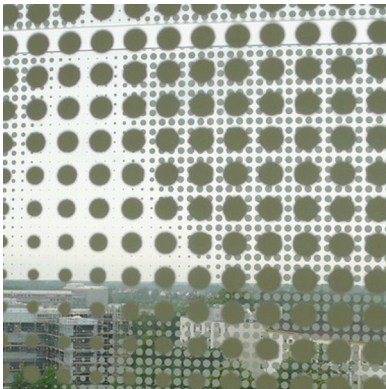
The diagrammatic design method employed in this building is encapsulated in the proportioning and orientation of its exterior surfaces. The building form was derived from a set of diagrammatic representations of the program. The program was arranged into blocks, stacked, and the blocks were then shifted to maximize sunlight exposure. This procedure used abstracted graphics from the program, and these generated flat surfaces on the building. The flatness of these surfaces reflects the diagramming process.

These planes are physically flat, but in addition they are flattened. Program was directly translated from written and square footage requirements to diagram, then to built form. In a sense, the building both contains the program and is contained by a flattened expression of the program. However the flattening mentioned here is not a direct reflection of the program. Rather, it is imprinted by the design process.

Besides its surface flatness, the library exterior is made of intersecting planes. Also, because of the diagrams involved in its design it retains a type of representational flatness as well.



Cottbus University Library
by Herzog and de Meuron



The graphic treatment of this library's exterior surface suggests its function. The glass walls are applied with large, overlapping typography. This text is printed in a newspaper-like way, where the size and density of dots which form the text determine the opacity and transparency of the glass is controlled by the size and density of dots.

Herzog and de Meuron are known for their treatment of building skins with graphics. The surface of this building is particularly interesting because it flattens function to an abstract representation, where typography is the signifier for a collection of books. This flattening is complemented by an unflattening as the graphic, originally flat, is given depth by its juxtaposition with the building's program.

The surface allusion to function in this case does not appear to have affected the form of the building as it did with the Seattle Public Library. It is an applied graphic treatment only on the building surface. The difference between the two is a result of what was flattened. In the first library, the diagram flattened textual content, and became a form. The Cottbus library selected a graphic placeholder for the function of the library, and coated the surface with it.



Santa Maria Novella

by Leon Battista Alberti

The facade of Santa Maria Novella suggests a more ornate construction using color and texture to create a three-dimensional effect on a flat surface. The masonry suggests depth where there is none, using familiar stylistic elements which are associated with more elaborate, sculpted decoration.

This flat configuration of masonry draws attention to the effect of color on surface. On this church facade, light colors stand out while dark bricks seem to recede, suggesting shadow and therefore depth. This effect is reinforced by slight variations in actual depth, confusing what is real and what is implied.



Chanel Tokyo Store

by Peter Marino

The dominant feature of this building is one side of its exterior, which is essentially a large screen, consisting of a grid of programmable light emitting diodes (LEDs). The lights are variable, hence the surface appearance is mutable and impermanent, not static.

Although the surface is static and geometrically flat, the lights give it the potential to suggest other spaces or textures, producing a dual effect for the viewer. This type of surface (typically a screen) is called a 'hypersurface,' and is characterized by the way it causes the observer's perception of it to oscillate between real and virtual space.¹¹ By enabling change in the surface appearance, the LEDs give it the added dimension of time.

The screen itself need not be flat like a plane to create this dual effect. The key characteristic is that it is a surface. Even if that surface was not flat the duality of built and depicted would still make it a hypersurface.

¹¹ Imperiale, p71.

Analysis:

In the library examples, the building surfaces are laden with meaning to outwardly communicate their function. The Chanel Store and Church both distort or camouflage their real depth by sending mixed messages through virtual graphics. Only in the Chanel Store was this confusion of space also ephemeral, since the programmable lights could produce fleeting images of virtual spaces.

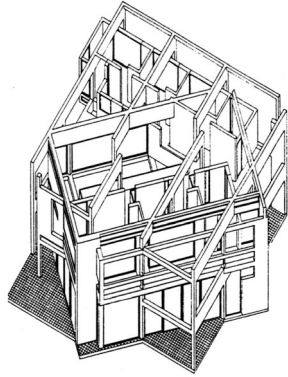
Layered:

(n) *“a sheet, quantity, or thickness of material, typically one of several, covering a surface or body”*

(v) *“arrange in a layer or layers”*¹²

Layered flatness relates to design process and technique. It describes the derivation of form from layered or collaged rules, particularly by drawing superimposed elements to generate abstract forms.

¹² New Oxford American Dictionary.

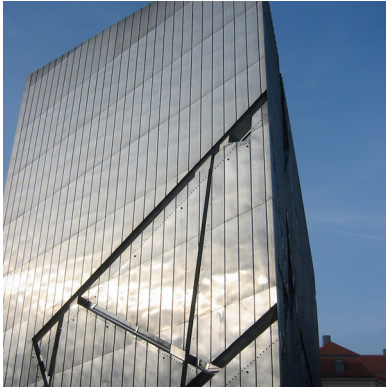


House 3

by Peter Eisenman

This is one of a series of houses based on a manipulation of geometric rules beginning with a simple grid. The house shows the superimposition of one rotated grid on top of another, as though the first plan has been layered with second, to create unexpected, abstracted, nonhierarchical spaces.

The important flat element here is the drawn tectonic and grid system. The drawing stores an idea of a space, then makes it possible for the architect to force it to overlap with itself by applying a set of rules (translate, rotate, etc.). The result is a conceived object occupying the same location simultaneously in two ways. The drawing as flat media is the tool used to convert that impossible condition to reality.



Jewish Museum

by Daniel Libeskind

The superimposition of historical maps and documents became the framework for generating this building's form. The overall plan is an extrusion of this layered rule set, and these rules were also projected onto surfaces throughout the building to generate details such as windows, or other interruptions and fragmentations of solid elements. The framework consists of documents like maps and lists. It also includes a star of David, and patterns from sheet music. These were all superimposed on the site, and defined the building form, which looks like a bolt of lightning in plan.

Layering this information flattened it in a graphic or textual sense because the original meaning of each layer on its own becomes inaccessible when they are superimposed. The layered information is flattened further as an architectural design is derived from the combined formal properties.

The museum may also be considered materially flat. It has a smooth, polished metal surface which is interrupted by gash-like lines. The scoring in the metal and the marked absence of other articulations (i.e. conventional windows and ornamentation) evoke a greater solidity within, like a volume rather than a building.



Laci and Lucia

by Laszlo Moholy-Nagy

Laci and Lucia is a photogram made by layering several exposures of light around different facial profiles. The layering causes light areas where faces overlapped, and darkness where the paper was most exposed to light. The intermediate shades are a mix of covered and exposed. Their hues reflect the degree of layering that has occurred.

This layering of a flattened projection of the figure abstracts the figure through the gradations of light and dark, and gives simultaneous impressions from opposite angles (facing left and right). The face is shown at intervals of time, like an unmeasured strobe photography effect. This photogram is an example of flattened time and depth.

Analysis:

Layered precedents are characterized by superimposition, relation to context, lack of hierarchy, and the suggestion of fragmentation. In each case, the original rules were abstract or abstracted by their use to generate a design.

Without clear, conventional hierarchy or order, the layered precedents draw attention to the method from which they were designed. House 3 is the clearest example of this, as the drawing brings to mind a rotating action. The photogram and Jewish Museum have less obvious, but equally interesting origins. Upon seeing them, one searches for the method or rule set from which they were derived.

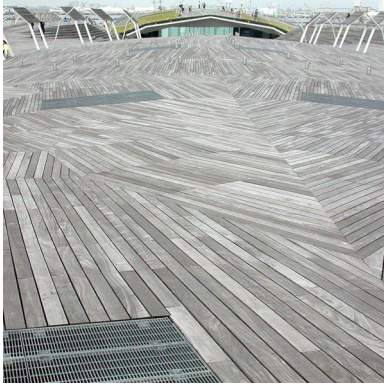
Topological:

*“1 **Mathematics** the study of geometric properties and spatial relations unaffected by the continuous change of shape or size of figures...*

2 the way in which constituent parts are interrelated or arranged”¹³

Topological flatness defines the flat as a surface that is continuous, complex, and smooth. It relates to interface, chimerical pairing, skin, folding, pliancy, and parametric design. Topological surfaces are shaped to incorporate convolutions and affiliations which form liminal conditions. The liminal spaces produced turn the surface into a thickened, ambiguous zone between the spaces on either side of it.

¹³ New Oxford American Dictionary.



Yokohama Port Terminal

by Jesse Reiser and Nanako Umemoto

The roof of the Yokohama Port Terminal is a topological interface between the interior (port) and exterior (park) programs. It was designed as a complex and continuous surface where the two programmatic elements engage one another while remaining separate.¹⁴

The gradually bending surface is moulded to incorporate moments of interface, and the result is a thickening of surface, where depth is derived from the complex conditions it creates. The flat roof is an imagined original condition, which has been unfurled into this complex configuration.

The implied original flat condition, and the thickening of the surface of the roof are reminiscent of Eisenman's Holocaust Memorial. This suggests that the roof could also be seen as the intervention of a terrestrial element - prying apart the ground to reposition the body and generate interstitial space.

¹⁴ Imperiale, p51.



Wrapped Reichstag

by Christo



This art installation covered the Reichstag with a continuous layer of fabric. The complexity of the building's ornamentation, as well as the damage it retained from World War Two, were obscured while keeping visible its silhouette. Instead, the parti was ornamented with the fabric as held in place by gravity and strategic tying. The fabric itself had superfluous surface area, and as a result was undulated, and this was exaggerated where the tectonics of the building tapered and the ropes bunched the fabric in place.

As a topological surface, *Wrapped Reichstag* is interesting because it was made from a simple material which was able to approximate or highlight the essential elements of an existing form while generating new patterns of affiliation because of its pliancy. It flattened the building exterior to a fabric surface, replacing ornament with undulating texture.



Strasbourg Hoenheim Tram Terminal
by Zaha Hadid



This planar, open structure connects to its context by way of geometry and materiality. The roof of the structure looks like a pried away continuation of the concrete parking space surrounding it. The geometry of the parking lot element extends through to the form of the station, folding up off the ground as a convolution of its surface.

The space is organized in a way that places the body in relation to that surface, rather than inside or outside of a volume. The functioning space is designed to exist in a flat top layer of the ground that has been pulled apart.

Like the Holocaust Memorial and the Yokohama Port Terminal, Hadid's design has an implied original flat condition which produces a thickened, transition between the ground and air.

Analysis:

Each precedent was designed around an existing or imagined spatial condition which was then flattened or pulled apart to create a new, complex interface. The Yokohama Port Terminal's intervened condition is a planar roof to which tears and undulations were introduced. The Christo installation combined one flat (the fabric) and one complex (the Reichstag) original condition. The interaction of the space created complexity in the fabric and an interstitial zone between it and the building exterior. The Tram Terminal treated the paved surface of the ground as a layer to be peeled away to generate new space.

Representational:

“of, relating, or characterized by representation...”

- *relating to or denoting art that aims to depict the physical appearance of things.”¹⁵*

Representational flatness describes space conveyed on a flat medium. Typically, it depicts one or two fewer dimensions than the represented thing possesses. The virtual and real, time, and diagram all relate to this category. Hypersurfaces are another type of representational flatness. A hypersurface is typically a graphic screen which, when observed, give the illusion of space. The viewer is able to alternate between experiencing the space they are in and imagining themselves to be in the space suggested by the screen.

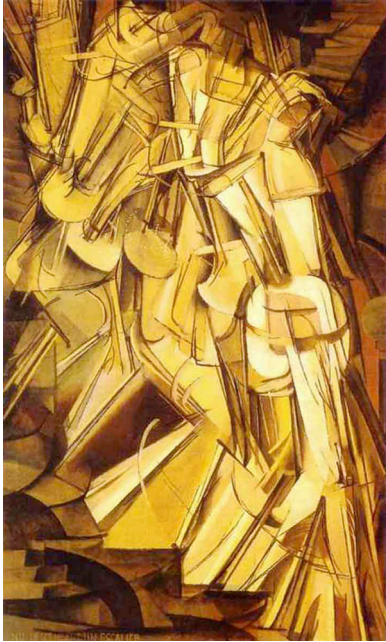
¹⁵ New Oxford American Dictionary.



Google Maps and Street View

The Google Maps interface is an example of hypersurface which allows causes the user to switch back and forth between virtual and real. This interface has added complexity because of the multiple options which the software provides for layering information. In particular, the Street View feature allows users to select a point on the satellite image or drawn map, and optionally view the street-scape from that perspective by way of digitally stitched photographs that create a panoramic perspective.

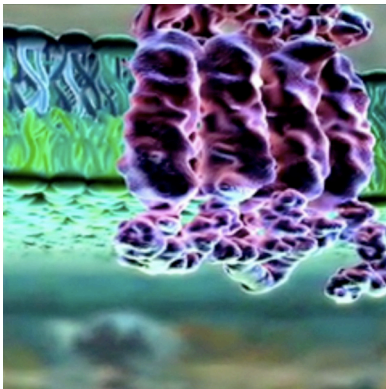
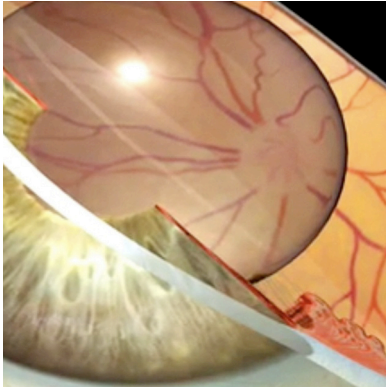
The ability to see both Street View and a satellite image simultaneously enables shifts in perspective: between floating above the Earth and imagining oneself in a particular location on the map. Street View is also navigable, and allows the user to pan and face any direction along a street, as well as walk down it. This interactivity of perspective mimics the added dimension of time, although the images in Street View are static.



Nude Descending a Staircase #2
by Marcel Duchamp

This composition is an abstracted depiction of a figure stepping down stairs. It flattens the figure from three dimensions to two, but also collapses its motion through time by depicting it as overlapping, filmic elements.

Instead of suggesting continuous motion, the rhythmic distribution of lines reminds one of stop-motion, showing intermediate, static positions between points in time and space. Rather than being strictly two-dimensional, the composition approximates the movement of a figure through the fourth dimension of time, but represents it within a space.



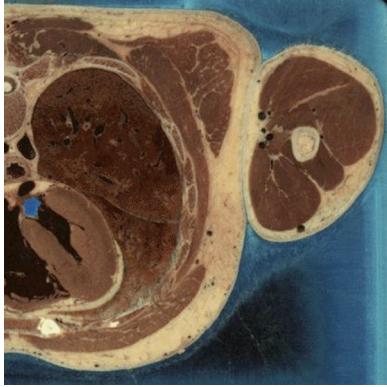
Animations

by David Bolinsky

This series of animations depict human anatomy at a microscopic level. They were developed for medical students at Harvard University and use three-dimensional models seen as video to depict cellular activity at a microscopic level. These videos portray the body from impossible viewpoints. These viewpoints, however, are not taken from real cells, and do not offer planar information (as looking through a microscope would).

The animations are artistic representations that are faithful to the mechanisms within the body, but designed with the intention of re-scaling the cell in the students' minds as a vast and complex space.¹⁶ As a hypersurface, the video allows the viewers to project themselves into a virtual space, along with perceiving their bodies in relation to the screen in real space.

¹⁶ David Bolinsky, TED lecture 2007.



The Visible Human Project

by the National Library of Medicine

This anatomical guide combines magnetic resonance imaging (MRI) data with cross-sectional images of the body. It relies on planar images of cadavers, which have been thinly sliced and photographed. Pictured here is a single thin slice of a frozen cadaver. It is one of a plethora of images and data collected as an aid for understanding the topography of the body. Viewing these cross-sections in quick succession as an animation imparts the body as a whole seen from a usually impossible viewpoint. The figure as is depicted in a way unlike how it is typically seen - from the exterior. Animated, the three-dimensional figure has had one spatial dimension removed, and replaced with time.

The constituent parts of the Visible Human Project are planes, and as such this example could also be categorized as planar in its still state (as images, rather than video). An MRI scan reads densities three-dimensionally and interprets those densities as electronic data. This data is typically accessible by converting it to a two-dimensional cross section. Its planar elements are portals which enable a point of view that has access beyond the surface of the body to every point inside.

Analysis:

In each representational precedent shown, the role of time is key. In the Duchamp painting, and the Bolinsky and Visible Human Project animations, there is a set progression of time. Google Maps has no set path, and though it changes with time, this change is unpredictable, and has no predetermined order.

Using a flat surface to suggest more than two dimensions is the common quality here. The precedents also create a perspective usually inaccessible to the body, by reasons of scale, orientation, or the boundaries of volumes in space.

Conclusions from the Taxonomy

The types of flatness examined in the taxonomy are diverse in both purpose and appearance. Yet they have in common the interface of spatial conditions and/or the body. The nature of their surfaces reveals how flatness is used to engage the body. On the subject of surface, Alicia Imperiale says this:

“Questions regarding flatness, it turns out, are not superficial, but quite profound. In its very nature a surface is in an unstable condition. For where are its boundaries? What is its status? Is it structure or ornament?”¹⁷

If any conclusion can be drawn from this taxonomy, it is that Imperiale’s questions only scratch the surface. Moreover, it has shown that the flat is a site for the resolution of many such conundrums precisely because it is a meeting point of conditions. It can be the site of the collision of opposites, or a site for clarifying complexity. Flatness is where and/or how ideas about space become tangible.

Flatness does not exclusively describe surface, but how a surface behaves is a significant characteristic of the type of flatness in question. Of the examples of flatness discussed in the taxonomy, quite a few use surfaces in a way that extends past physical bounds into adjacent space. Nouvel’s museum uses it to disappear. Hadid pries it apart to examine the liminal. Bolinsky’s animation uses the screen to create impossibly small perspectives, making the outer surface of the body irrelevant to what can be seen inside.

However, two topics are missing in Imperiale’s statement but appear repeatedly in the taxonomy. The first is the necessity for a relationship with the body, as surface and flatness can only be meaningful in the ways that they interact with or

¹⁷ Imperiale, 5.

engage the body. Second, the taxonomy reveals flatness as possibly either a start or end condition. In some cases (particularly the topological), the spaces themselves were not flat, but have implied original conditions. In others, the effect was a flattening one, either reducing or dissecting things into flat components.

In the taxonomy there were also several recurring attributes which overlapped categories. For example, reflectivity was used to create play between volume and void, or interior and exterior. Similarly to the use of reflection (typically using glass), thin planes tended towards dematerialization or reduction. Another interesting mode of flatness was a repositioning of the body, either through disorientation, simultaneous interaction with the real and the virtual, or its use to show usually hidden information. Thickening of the flat was also observed in several cases, where surface was affected to create complex space.

Connection to the Experiments

The specific characteristics found in the taxonomy are to be further explored in the experiments. The purpose of this process is to isolate those characteristics in a simpler context to discover their nature. Aspects of flatness to be included are chosen partly by the taxonomy, but also generated by the specific material conditions in the experiments. The experiments are therefore not all analogous to a taxonomical precedent or specific type of flatness. Rather, in those cases the experiment should present new information to contribute to the complete definition of flatness.

Flatness is to be examined as action in the experiments. Therefore, each one will have an original and end condition, with a flattening or unflattening motion in between. This should elaborate on types of flatness which are either initial or final conditions.

The experiments will explore relationship to the body as another theme of flatness. The first set of interventions are to be conducted by the body and on objects which are designed to relate to the body (books). Complexity, convolution, and the generation of new spaces will also be explored in the experiments. Such themes will be examined against the definitions established in the first part of this document.

Book Three: Action

Chapter One: The Book as Site

The Book as an Object

If one considers the generic book, it is an object which can be held comfortably in one hand. It is composed of many pieces of paper which are bound together at one end. This spine performs three functions; it holds all parts together, it acts as a flexible pivot point, and it adds rigidity to a very bendable material. Its design facilitates its handling and use.

The book uses text and sometimes images to finitely illuminate a particular subject. This content could be narrative, poetic, graphic, or factual. Whichever it is, the ideas the book conveys are not wholly described within the object itself. Rather, they are organized into collections of words which are placeholders for those ideas. Those ideas are stored in the book, and become accessible to any one who chooses to pick up and engage with the object.

As an object, the book has a very specific set of material and logical qualities. There is a linearity and continuity to the content. The organization of pages is sequential. The pages are repetitive and uniform units which, when in use, require the repetitive motion of page-turning. They rely upon their flatness to function. They are stackable and light because they are flat and thin. Their flatness also allows them to bend when the book is in use, repositioning themselves around the opened page. The spine connects, and acts as a flexible joint in this position, by curving to accommodate pressure applied, and orienting the pages accordingly.

Gray's Anatomy: Background

Gray's Anatomy was selected as a site for experimentation with flatness for two reasons. First, as a book combining text and images, it provided flat conditions in both the visual and intellectual sense. Second, its subject matter provided an additional layer of significance to exploring flatness in architecture. Gray's Anatomy is about the human body, and it reflects knowledge about the body, while architecture reflects knowledge about the body inhabiting space.

Gray's Anatomy is a medical reference book that was first published in 1858, and has since been continuously revised. The 40th edition of the work is expected to be published in August of 2008.¹⁸ Changes to the original text have reflected changes in printing technology, medical technology and knowledge, as well as its evolving uses. These issues have shaped 150 years of editorial choices made within the original configuration of the book.¹⁹

That original concept had two components: text and illustration, based on dissection and study of the human body. Its success was credited both to this clear format and its physical practicality.

¹⁸ Richardson, p2.

¹⁹ The book's original text, written by Dr. Henry Gray, was organized by system (e.g. muscular, cardiovascular, and skeletal). Major changes to content over the years included an addendum on Histology and Embryology (2nd ed., 1860), and the inclusion of a bibliography (35th ed., 1973). Formatting of the text was itself changed infrequently, with the 35th edition having the most significant alterations, including 780 pages of rewritten text, and a complete resetting of the book.

Gray's Anatomy illustrations were originally drawn by Dr. H. V. Carter. These compositions differed from typical medical drawings of the time because of Carter's clear and schematic drawing style. This clarity, however, made a rough transition to new printing techniques in the late 19th and early 20th centuries. Problems printing these new, less detailed or naturalistic images weren't really resolved until photolithographic techniques were refined. With time, the product of new imaging technologies seeped into the book's content, notably including X-rays and electron microphotographs.

Gray's Anatomy outshone competing pocket references, which tended to prioritize portability by sacrificing text readability and illustration size. The first edition of Gray's anatomy was larger, but still small enough to be portable. The swelling proportions of subsequent editions reflected growth in medical knowledge. After its mass peaked at 5 pounds 8 ounces at the turn of the century, the editors of future editions did their best to restrain the volume in size without sacrificing content.²⁰

In more recent years, the book has undergone perhaps the most major of its transformations, with the conversion of old editions to digital media, together with publication of the 39th edition on the internet as graysanatomyonline.com. The volume as an object has transformed alongside new ideas and technology. The availability of internet access is great enough that accessibility, as opposed to portability, is now a driving force behind the design of the 'book.' Nonetheless, Gray's Anatomy is still available in its original medium in various incarnations designed for specific uses other than its original use as a reference for students.

The scope of Gray's Anatomy is confined to the healthful state of the body, with all the systems in working condition. It depicts a generic, healthful, average figure in text and illustration. Illnesses are excluded from the content, as is psychology. Also, descriptions of the various systems are limited in detail by the size of the book. With too much information, it would be too cumbersome to work as a general reference guide within the physical boundaries of the book.

²⁰ *Ibid*, at p6.

Chapter Two: Exercises on Flatness (Part One)

Introduction

The following step in this project is to seek pure observations about flatness by further exploring the properties observed in the taxonomy, as well as terms which arose in the definitions. These experiments seek out latent or secondary properties of flatness by applying of a simple external force. Each such force is determined by the possibilities and properties of flatness already discussed.

The experiments in this chapter each use a copy of the 1910 edition of Gray's Anatomy as a site, or 'original condition.' Observations are to be organized into steps: original condition,²¹ intervention,²² altered condition,²³ and conclusion.²⁴ Gray's Anatomy is used as a site in this chapter because it is seen as a controlled variable. By keeping this condition consistent, it is easier to compare and contrast the experiments without having to factor in different materials.

The original condition in the experiments to follow is a book which is both visually and textually flat. It is comprised of uniform, flat units connected at one edge by a spine. The book is thick and heavy, such that it can be held in one hand, but not comfortably for an extended time. It is orthogonal and solid.

²¹ The state of the object at the beginning of the experiment.

²² An external force which is consistent and simple. It can be thought of as an agent of change acting upon the original condition.

²³ The state of the object after the experiment/intervention.

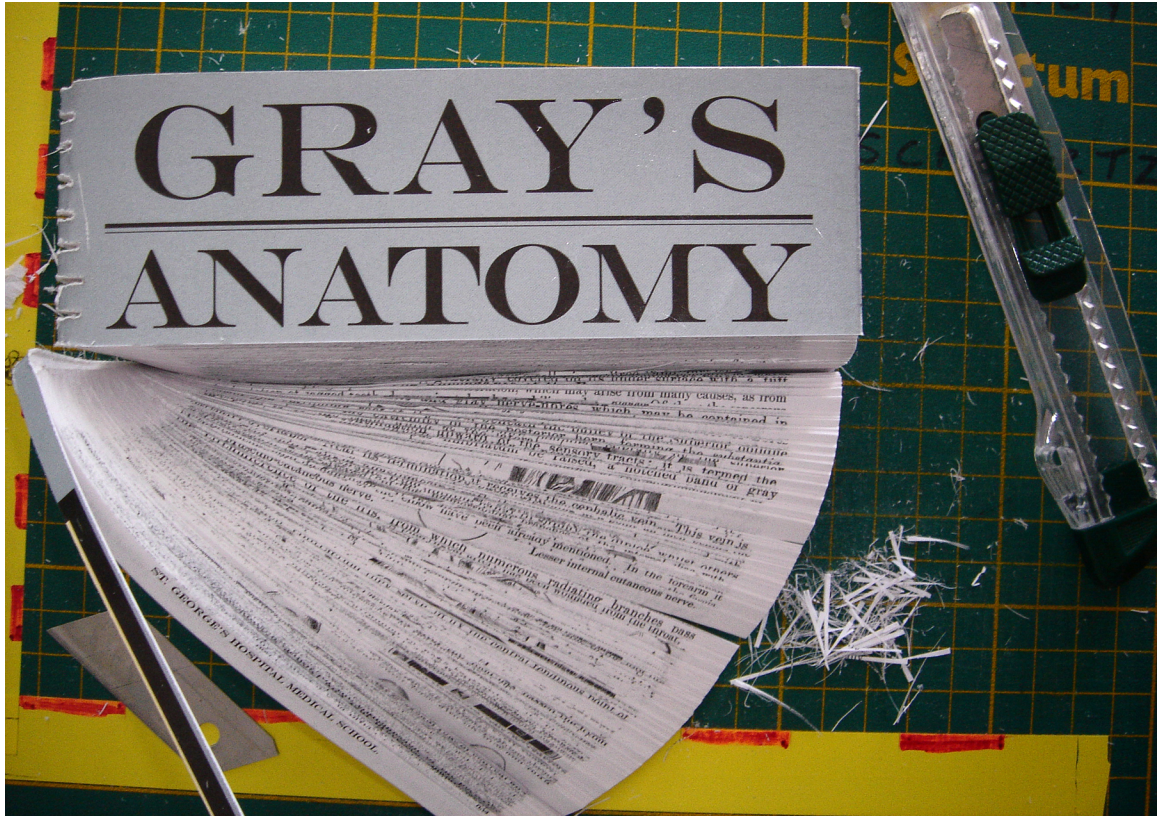
²⁴ A comparison of the altered to the original condition and its relation to taxonomical precedents where applicable.

Excavate

Intervention: A subtractive process was undertaken, cutting and removing parts of each of the flat units, as guided by a set of arbitrary content-driven rules. This process began at the front of the book, and produced a void inside of the object as a terrain was carved away, page by page.

Altered Condition: At completion, the object contained a void, which revealed fragments of the surfaces of multiple pages. The shapes produced by the intervention were guided by the content of the book, but also limited by the book's thickness, and the boundaries of each page. The edges of the page were kept intact to ensure that all parts of the page meant to remain were still connected to the spine.

Conclusion: Here, the process of peeling away layers is similar to Peter Eisenman's Holocaust Memorial and Hadid's Tram Terminal in that it illustrates volume by revealing multiple flat layers rather than just one. The experiment and memorial also have in common the juxtaposition of gently sloping terrain with vertical volumes. Like the memorial, this experiment exposes a dimension of depth which is usually hidden behind the surface and then brought forth by excavation and extrusion.



Slice

Intervention: Slicing was applied to the book with the aim of re-proportioning it such that its dominant flatness would be changed. The final flat units were a different shape, oriented perpendicularly to the initial flatness (the pages).

Altered Condition: Dividing the book by thinly slicing it transformed a single, solid object into a collection of more flexible, fragile items. The slices exposed views of the book which didn't previously exist, as cross-sectional views at each cut. The forces at play in these cuts (twisting caused by the spine, limitations of the knife and saw used) were all reflected in the slight irregularity of each cut. This created an unexpected condition where patches of dark and light on the surface of each slice were caused by the position of the text.

Conclusion: This experiment shares the phenomenon of exposing the concealed with the Visible Human Project. However, whereas the latter uses animation and combines photographs with MRI data, the book slices come from a single source and can only imply motion or change by being placed in order.



Disciplined Misalignment

Intervention: The top right hand corner of each page was stapled such that those corners were forced out of alignment, creating new exterior surfaces and interior spaces in the object.

Altered Condition: In contrast to the original condition, the object in its altered state fanned apart and the pages wrapped around empty space. The top surface was no longer orthogonal, but curved around the spine and undulating vertically, producing a flouncy texture.

Conclusion: This condition is repetitive and stepped in texture, and exposes multiple layered moments in the book in the way that Duchamp's painting depicts the figure in overlapping moments in time. The experiment created spaces between the fastened, misaligned pages. Similarly, the painting uses lines to demarcate motion, dividing it into instants rather than a continuous time axis.

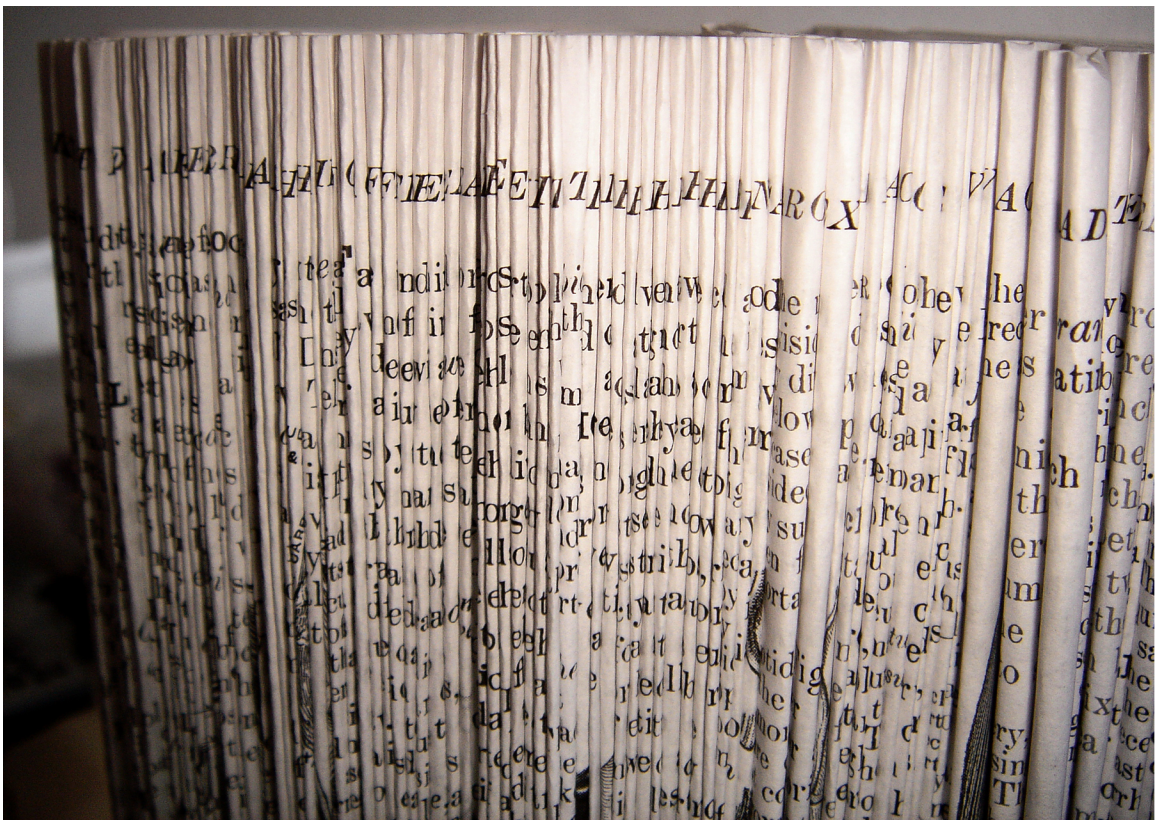
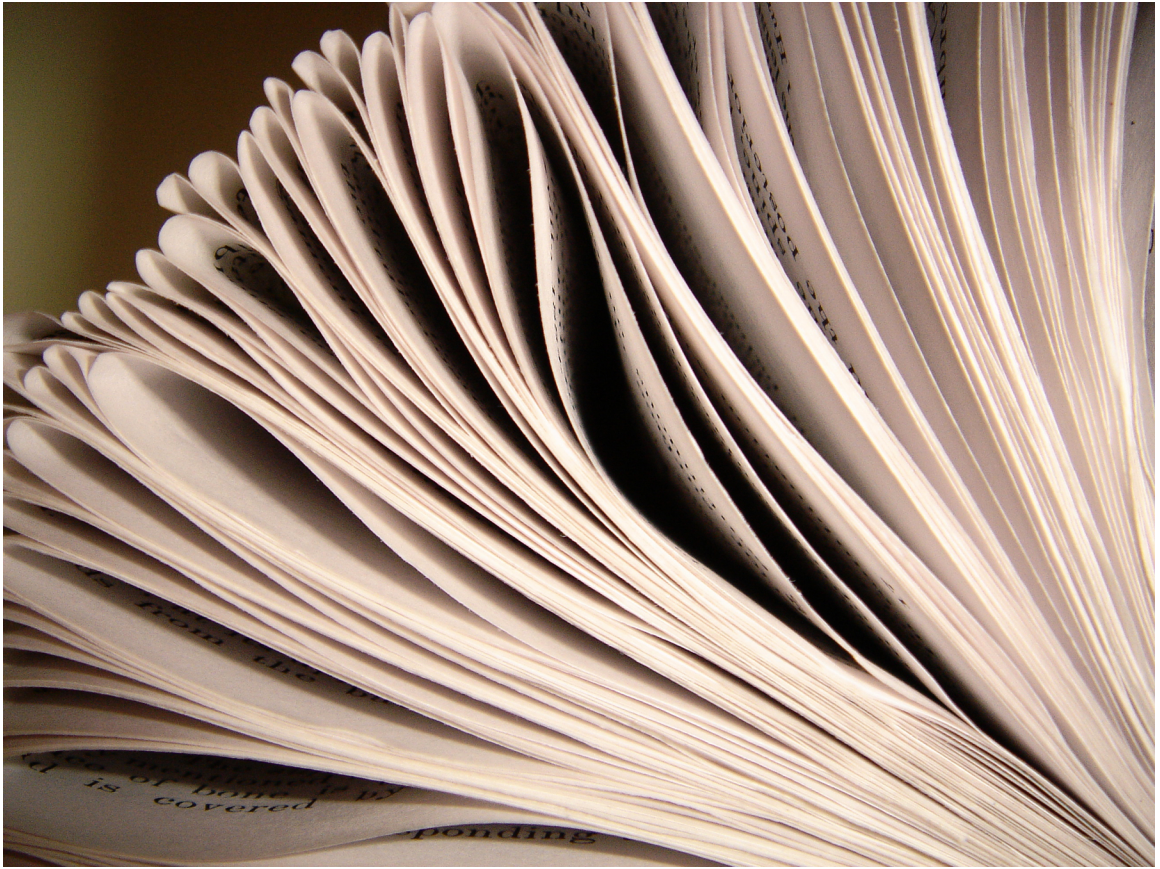


Fold

Intervention: A sine wave was drawn on the book face opposite the spine, and each page was folded at the points where it intersected with that line.

Altered Condition: The folding caused the pages to double up, and the unbound edges were thickened so much that the pages wrapped all the way around the spine. This exaggerated the sine wave diagram to the point of obscuring its original curve. It also completely changed the tectonic of the object from orthogonal to radial, suggesting the proportions of a nautilus. In addition, the folding action decreased the density of the pages, which caused a textural change to softness and pliability to the touch.

Conclusion: The generation of form using a diagrammatic set of rules was also the type of flattening and abstracting information used in the Seattle Public Library. In both the building and the experiment, the diagram became the form. However, whereas the diagram used to shape the library, was a flattening of the building program, the sine wave on the book was arbitrarily chosen.

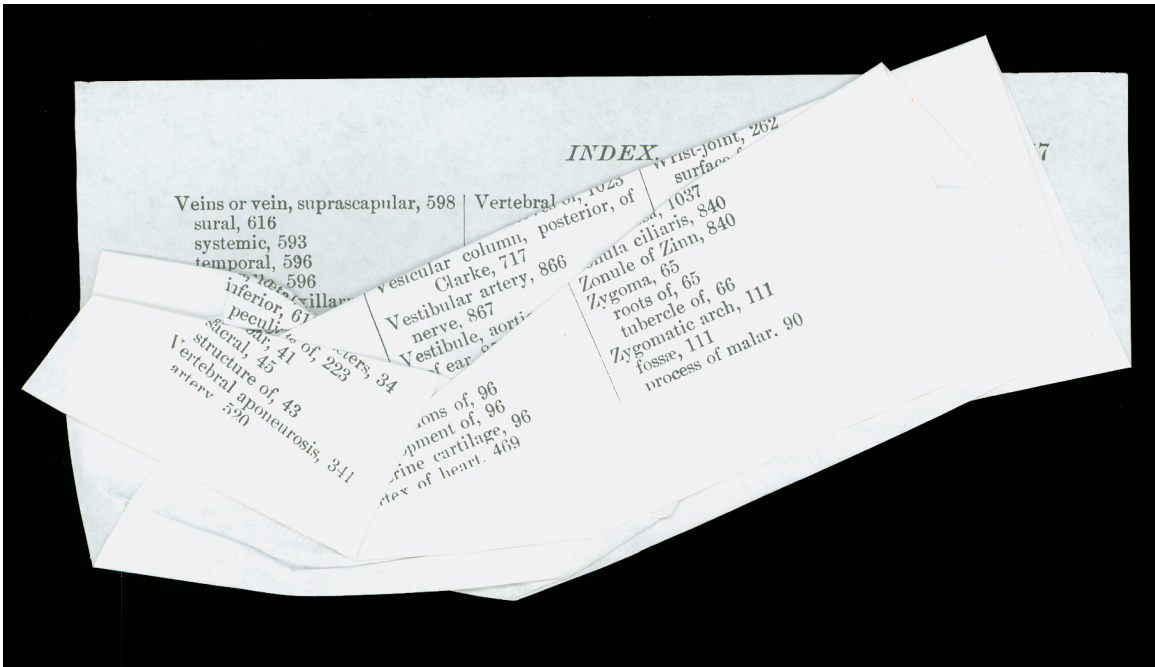


Bend in Half

Intervention: The external force acting upon the book in this experiment was a doubling back of each page towards the book's spine. Doubling the pages back individually in this manner effectively warped the spine.

Altered Condition: The intervened object obscured four of the six original visible surfaces, and changed the shape and texture of the remaining two (top and bottom edges). The circumference of the book exposed narrow columns of interior content, like a thickened cross-section. The curves of the uncreased folds exerted pressure on one another, causing slight unevenness, bunching, and most notably, a stiffness and rigidity throughout the book, from spine to outer boundaries.

Conclusion: The "thickened cross-sections" of this book has a filmic quality in common with several taxonomical precedents, including the Visible Human Project and the Duchamp painting. The book is like a film because it creates an impression of continuity (text lining up, patterns from page to page) when in fact it exposes only a small sampling of the text. In motion pictures, a similar effect occurs, in which the eye sees still images and is able to extrapolate the motion in between the actual still images shown. The Duchamp painting represents this process rather than implementing it. One does not look at the painting and see a moving figure. The Visible Human Project is less like this experiment and the Duchamp painting because it does appear to have motion when the body cross-sections are seen consecutively as a video.



Crumple

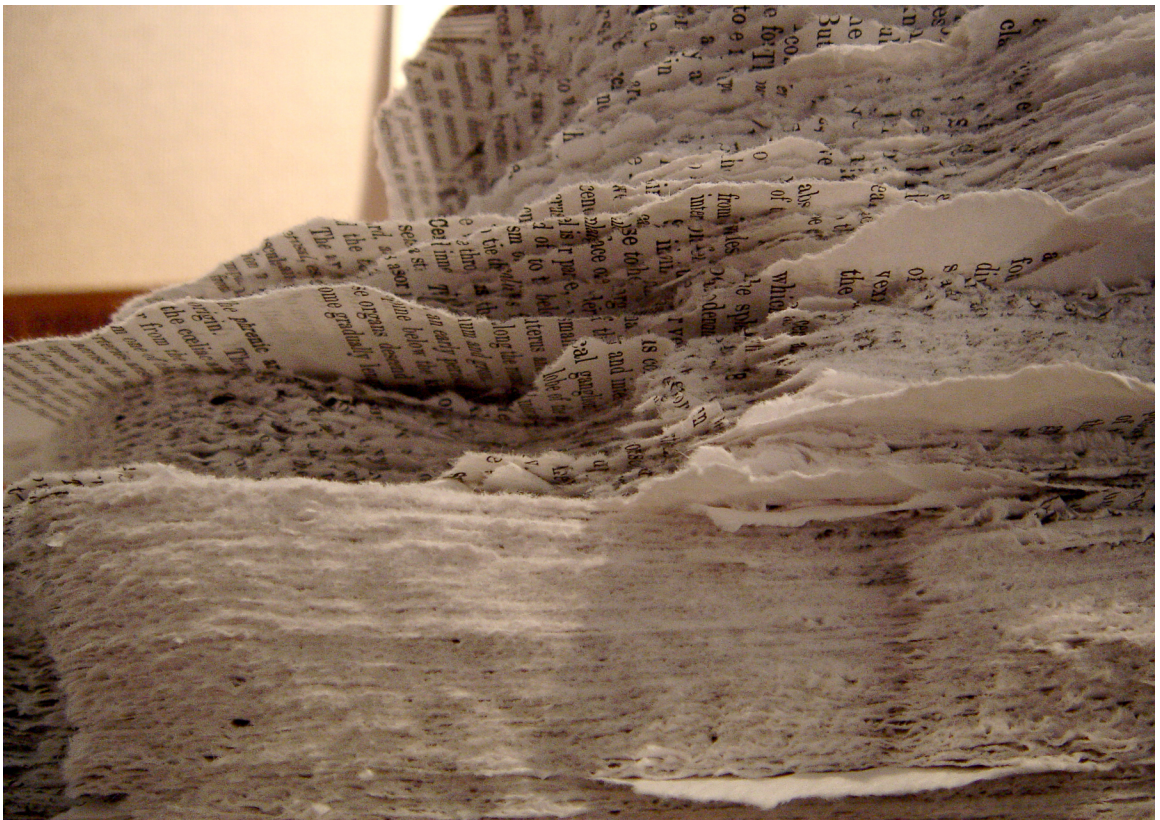
Original Condition: In contrast to the other book experiments, this one used a single flat page from *Gray's Anatomy* as the original condition. The object began as a smooth, flat, flexible, orthogonal piece of paper. Its two sides were facing in opposite directions.

Intervention: The paper was reconfigured using a chaotic, crumpling force which created volume, followed by a controlled flattening force which compressed and stored the crumpled result. The small, irregular surfaces produced by this process were then dissected, by cutting at the creases and arranging the separated elements into layers in their relative positions.

Altered Condition: This intervention caused a fragmentation of the original smooth surface into smaller, creased, layered parts. These smaller units of surface had new affiliations with perviously remote areas of the page. This condition was possible because of the pliancy of the object, and the folding that resulted from applied complexity and re-flattening of the surface. The folding also arbitrarily obscured and exposed parts of the page. Whereas all parts were once external, now some surfaces were wrapped within multiple layers produced by the folding. Even with this added interior / exterior condition, the distinction between these conditions is ambiguous because of the object's continuity.

Conclusion: Ambiguity and continuity of the altered condition are qualities also found in several of the taxonomical examples. For example, the facade of Nouvel's museum creates an ambiguity, but not by the same procedure. Rather, it confuses what is interior and exterior by obscuring the building's volume through materiality and proportion. This experiment's material provided a very different context for this ambiguity, but its flexibility allowed a similar effect where the boundaries of surface and interior are in question.

The continuity of the surface in this experiment is analogous to the topological projects in the taxonomy. For example, the single surface of the Yokohama Port Terminal Roof was designed to maintain a thickened, continuous boundary between the port and park functions. Just as those functions remained separate, so did the opposite surfaces of the page. However obscured or warped, those surfaces are still bound by the same edges and hence remain distinct. The complexity introduced by manipulation of the material doesn't change the fundamental separateness of the two. However, by intervening on the page, new conditions of interface punctuate the two sides.



Tear

Intervention: The flat elements of the book in this experiment were torn out individually to produce a remaining skeletal spine, and a pile of loose, ripped pages. To observe changes to and approximate their original relative positions, the pages were glued back together.

Altered Condition: The size and proportions of the pieces torn away were directly affected by the presence of the spine. Though the tearing action was consistent, each tear was unique, and shaped by the remains of the previous torn page(s). The cumulative effect of this was that the tears produced an uneven, but geological surface of varied texture.

An unexpected altered condition was produced by gluing together the torn pieces, when the arbitrary placement of glue between each page created joints within the new object. When stretched apart, the new object bends to accommodate these joints, creating curved, in-between spaces scattered between the pages.

Conclusion: The accidental production of liminal space in the final condition is reminiscent of Zaha Hadid's train station in that layers appear to be peeling away from adjacent surfaces. The suggestion of motion in its angles is mirrored in the actual mutability of the glued pages. In addition, the acuteness of the diamond-like shapes produced in the book recalls the angularity of the station's form, which accentuates the idea of the liminal. If anything, the ephemerality and unpredictability of the in-between spaces of the book make them even more liminal.

Summary of Findings

Each of the experiments conducted on Gray's Anatomy had in common a change from simple to complex spatial relationships, as well as an alteration of what regions of the book were interior and exterior, be it through bending, cutting, or otherwise. Generally, they showed a convolution of surface, shown secondarily as in the *slice* and *tear* experiments, or as a primary alteration in *misalign*. In addition, the experiments consistently altered the hierarchy of visible and hidden parts of the book. The exposure of interior or generated surfaces, and book content were altered conditions which dramatically changed the textural appearance of the books.

These characteristics were evocative of topological precedents in the taxonomy, as well as precedents that treated flatness as planes affected by some external force (such as slicing, prying apart, or convolution). Thematic connections to the taxonomy frequently involved the presence of flatness as an original or altered condition, revealing in more detail the idea of 'flattening' and its opposites (thickening, affiliating, etc.).

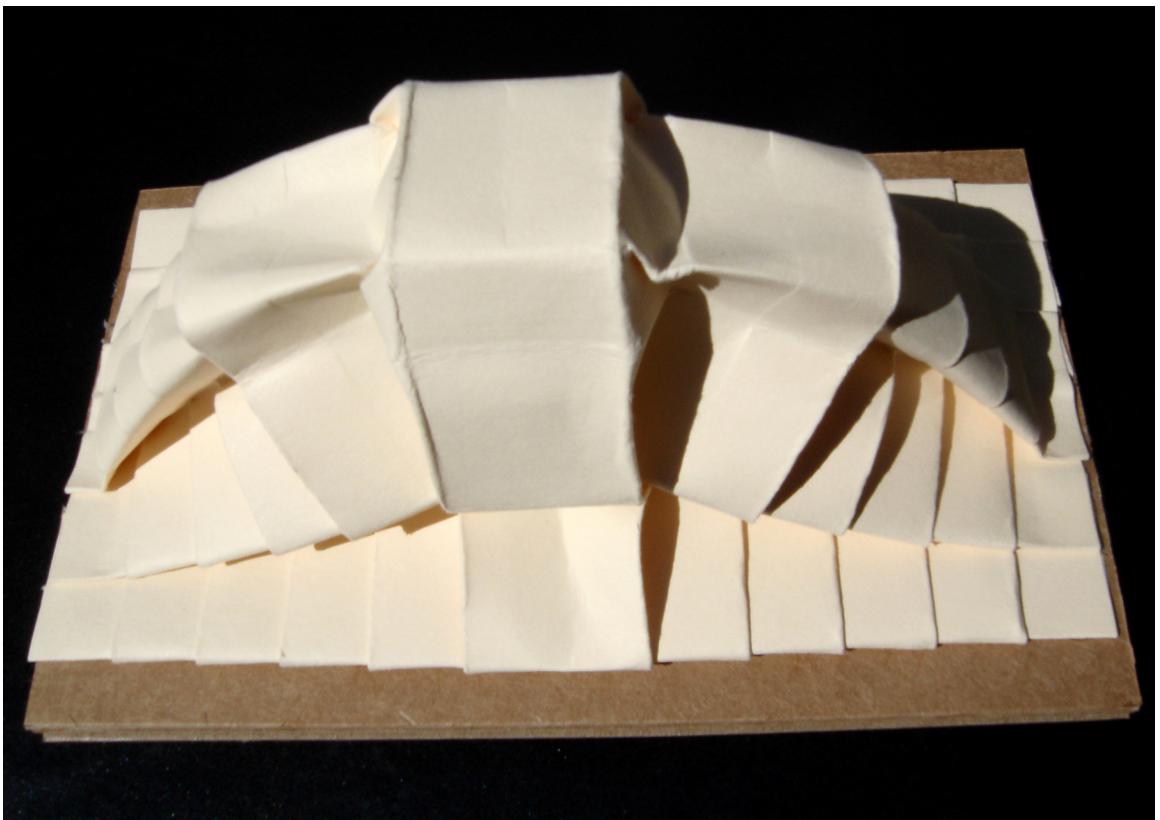
As in the taxonomy, the experiments repositioned the body with relation to the object. In most cases, the book content was made partly or wholly inaccessible to read. This made the books into new objects that related to the body as textures, volumes, and patterns.

Chapter Three: Exercises on Flatness (Part Two)

Introduction

The design of the second set of experiments is intended to exaggerate, invert, or otherwise respond to these topological themes picked out from the previous chapter. They use different, more varied materials, and further build upon the key observations from the book experiments. The new materials are simple and flat, such as paper or cardboard, and as a result are less complex objects than the books.

The following set of experiments will further explore flatness as start and end conditions, and as a generator of new types of space by way of interventions or agency. It will also continue to examine flatness in relation to the figure.



Repetitive Fold

Original Condition: The original condition was a square of thick, stiff, planar, flexible paper.

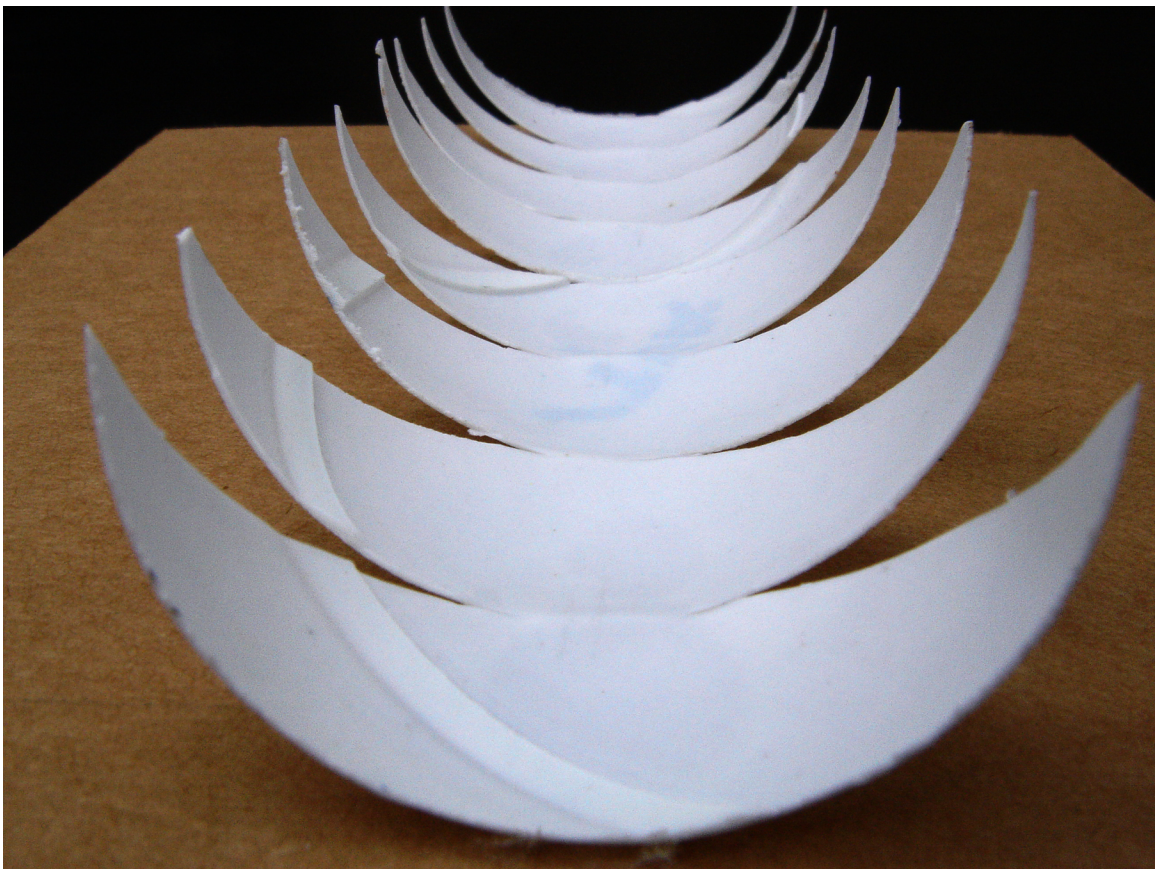
Intervention: Two perpendicular sets of parallel folds were applied to the paper. Alternate parallel folds were zigzagged. The folded object was then secured to a backing, and the center square which resulted from the folding was pulled away from the backing.

Altered Condition: The altered condition of the object was derived from an intermediate condition, which was flat but layered. The pulling action then produced a new convolution of space from that layered condition.

Conclusion: Folding the paper in this experiment generated new affiliations in the surface, echoing the *crumple* experiment. Comparing these two, the key differences were that in this experiment, the new affiliations were patterned, not arbitrary, and the change from intermediate to final condition thickened the material, rather than re-flattening it.

The *double back* experiment was similar to this one in that the resultant forms were both more rigid than the originals. In both cases, the elements were folded back upon themselves. In the *crumple* experiment, rigidity accumulated as a single action applied to many units. In the *repetitive fold* experiment, rigidity resulted from repetitive folding.

The folding in this experiment enabled a puckering effect on the surface. The possibility of using folding to warp a flat surface is suggestive of the continuous and complex surfaces in the taxonomy. For example, the Tram Terminal and the Yokohama Port Terminal both manipulate surface to thicken it as an interface. This experiment similarly created a third condition from its original two-sided material condition.



Section

Original condition: A hollow, plastic ping pong ball was used for this experiment. In its original state, the object was spherical, rigid, and light.

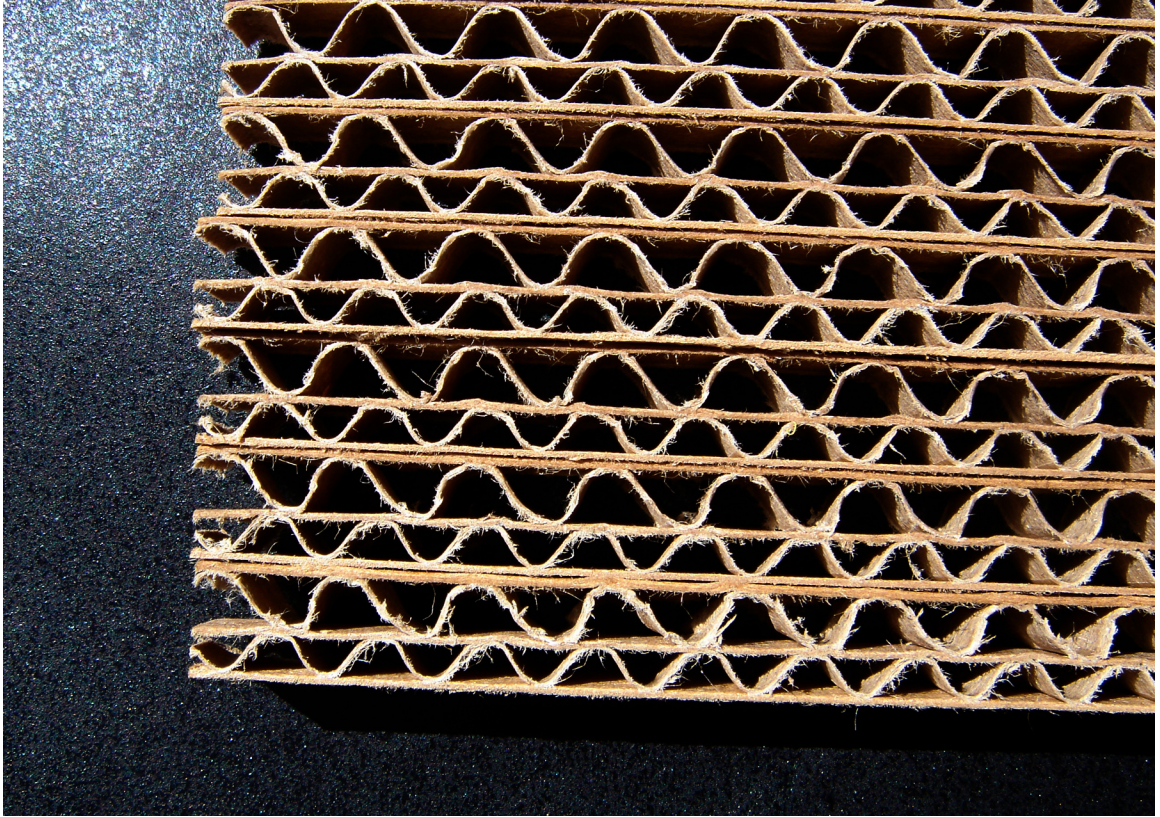
Intervention: The object was cut into eight wedged sections. These sections were left attached to one another on either side, and arranged into a flat row.

Altered Condition: The proportions, continuity, and rigidity of the ball were all changed, but the convexity of the original surface remained intact.

Conclusion: The altered ping pong ball was distinctly different from its original state in two ways. First, the boundary between the inside and outside was disrupted, removing any hierarchy between them. The radial cutting that did this simultaneously transformed the object from smooth, simple and regular to an object with many points, as well as multiple connected (but distinct) parts.

The unfurled ball's lack of inside and outside dialectic can be compared to the ambiguous boundary created by the facade of Nouvel's Fondation Cartier. Like the reflective glass of that facade, the continuity, beginning, and end of the ball's surface as boundary is not easily ascertained.

The fragmented effect of the cutting also shared attributes with Eisenman's Holocaust Memorial. The memorial is similarly a collection of units, and these units are arranged in a way that suggests the separation of a continuous surface. The Memorial, too, produces an ambiguous space that is neither above nor below ground, just as the ping pong ball is seen neither from the inside nor outside.



Slice Part Two

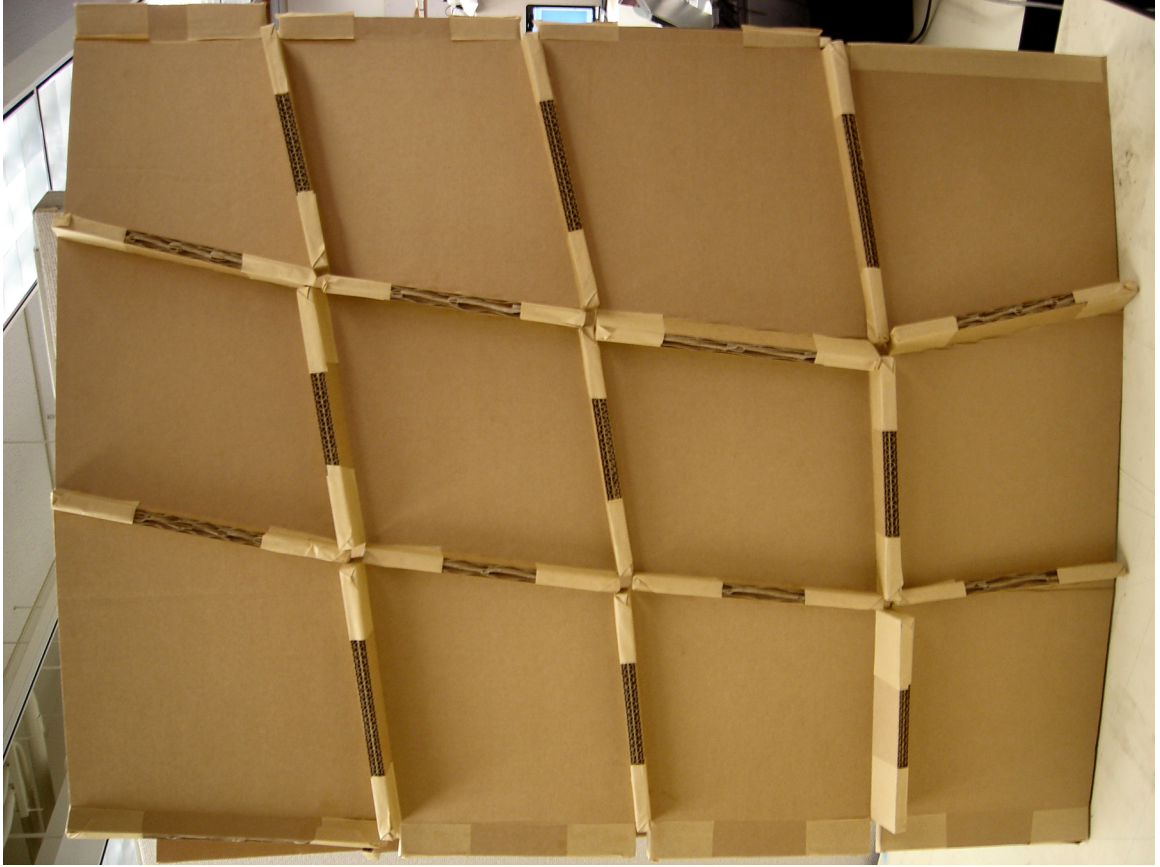
Original Condition: Two 12" squares of flat, double-corrugated cardboard.

Intervention: Both squares were cut into quarter inch strips (equal to the thickness of the material), reoriented by a quarter turn, and glued back together. In the first case, the cuts were perpendicular to the corrugation. In the second, they were parallel.

Altered Condition: The result was two reconfigured squares of cardboard. The first image shows how the perpendicular cuts changed the material from opaque to porous. The second has a striated, irregular but repetitive texture. The second was also found to be very flexible and delicate, whereas the first was essentially as rigid as the original condition.

Conclusion: This experiment was a continuation of the sliced book experiment, and produced a mix of similar, and new results. The differences had much to do with the difference in materials. Like the book, the altered cardboard provided new views of its inside. The exposed narrow sections of the interior's structure and tectonics. The porosity of the one and flexibility of the other are quite different in materiality and appearance. However, they are similar in the sense that they alter the boundary between the opposing surfaces, allowing them to affect one another because of physical changes to the dividing plane.

Like the Seattle Public Library, the Cottbus University Library, and the Visible Human Project, this experiment brought its function to the surface. The corrugation of cardboard is the strengthening element, and it's the part of the material of which one only sees a tiny edge. Just as the described taxonomy precedents expose the interior function or relationship of interior parts, the sliced cardboard shows its interior system.



Matrix

Original Condition: One 4' x 8' x 1/4" sheet of rectilinear, planar, cardboard.

Intervention: A non-rectilinear mesh system was created by scoring, cutting, and gluing the cardboard, but without deviating from the constraints of its original plane.

Altered Condition: The intervention caused greater mutability in the cardboard. Glued sections became joint-like seams which allowed the surface to be bent and reconfigured in different ways.

Conclusion: Segmenting the original condition into a flexible matrix of small units unflattened the object in the sense of being manipulable through time. This added dimension can be compared with the Tokyo Chanel Store, which uses video on its facade to change its appearance over time.

The cardboard matrix is different from the store in that it does show virtual space overlaid on real space. Instead, it physically moves when manipulated. It responds to direct manipulation, and it stays in certain positions only when the body itself is in a particular position, holding it in place. So rather than prompting observers to think of themselves both in real and virtual space, it engages the body physically.

A Reflection on the Experiments:

With this second set of experiments, the thickness, convolution, and mutability of surface were again the emerging themes. Examining flat conditions, and altering them to create new configurations or definitions of flatness reveals the complexity and many potential configurations of flatness. Of all the ways of altering flat conditions, topological reconfigurations of flatness seem to rely most on flatness itself. The very definition of topology is inextricable from surface. The taxonomy included many uses of flatness that relied on material characteristics, the physical flatness of things such as concrete slabs or glass panes.

Topology and surface were the two categories that related most closely to the experimentation with flatness. This appears to be the case because they interpret preexisting conditions as layers of surfaces that can be manipulated or changed to create space. That contrasts strongly with an understanding of space as something Cartesian, embedded with an invisible grid, waiting for planes or volumes to be filled in. The topological conception of space relies more on flatness, envisaging the plane as a starting point, and as something that is continuous, ambiguous, and a palette for creating more complex conditions. The experiments similarly had flatness as a starting condition, which probably accounts for the similarity between conditions created and topological precedents in the taxonomy.

Therefore, it should follow that the final installation of this project should be a further examination of topological space.

Chapter Four: Final installation

Intent

The final step in this project is to unify the themes and attributes from the taxonomy and experiments into a concept for a final installation. Upon further examination of the key words that appeared in both precedents and experiments, it is possible to organize and group them. To do so, their relationship to the original definition of 'flat' must be teased out.

The dictionary definition describes flatness as an absence or lack of other qualities, such as depth, slope or height. 'Flat' is defined by differentiating it from what it is missing, or what it is not.

In contrast, attributes from the taxonomy and experiments are positive descriptions of flatness. They can be divided into types. Some findings describe what a flat surface might be like. This type of attribute includes adjectives such as translucent, planar, horizontal, thin, and continuous. These appear to the onlooker through sight or touch. Other observed aspects of flatness describe how flatness can be intervened upon, or what can be created from or changed about flatness. These terms include layering, affiliation, convolution, prying apart, and thickening. They imply a start and end condition, of which flatness may be either. They also affect how flatness engages or relates to the body in space. The final type of attribute consists of traits that are created by such interventions. Words that appear repeatedly include ephemeral and ambiguous. However, this third type is open to a plethora of possible qualities. It can therefore be summed up as the infinite possible configurations of flatness, and is too ambiguous to be useful in arriving at the full definition of flatness.

The descriptors of flatness both overlap with the dictionary definition, and fill in some of the details, particularly by revealing what sort of materials appear in architectural examples. For example, glass is frequently configured in ways that dematerialize or obfuscate the interface between volume and void.

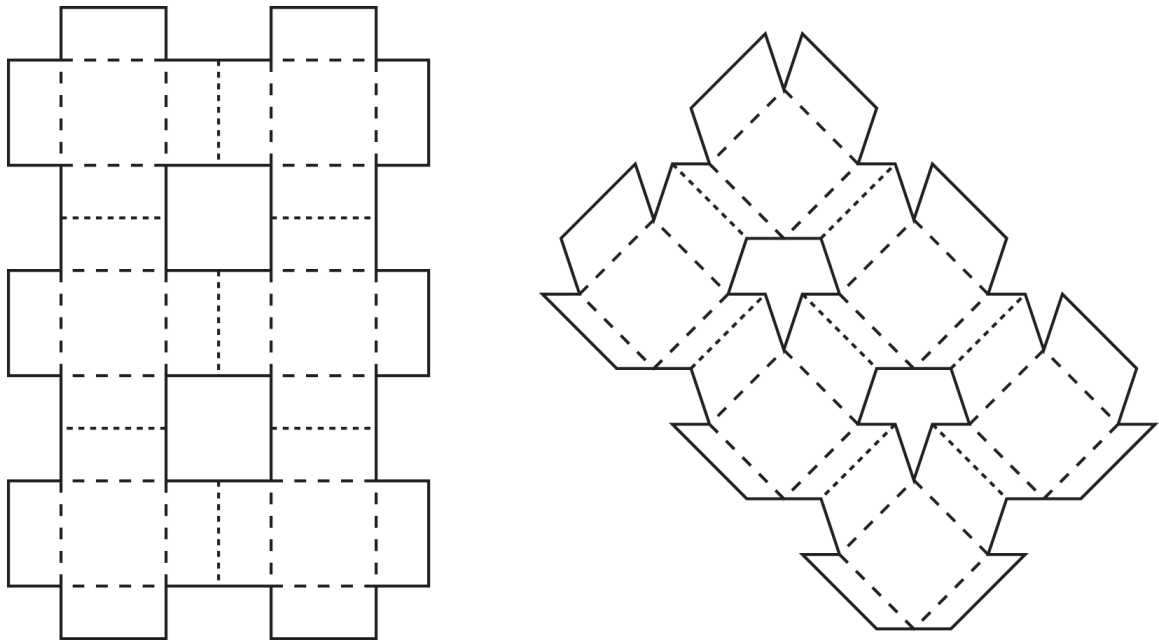
The second type of characteristic revolves around interventions in flatness. They describe how something flat can be positioned or altered to create a new condition. The common thread through all these alterations is the theme of expansion and contraction. They simply describe the orientation of the paired phenomena. Expansion and contraction complement one another as actions in the context of flatness because if a flat object expands or contracts in one direction, it is bound to do the opposite in at least one other direction. This duality will be examined in the final installation.

Whatever the exact details of these actions, the presence of flatness accounts for the ambiguity and continuity of any conditions that arise. Ambiguity exists because of the manipulation of a boundary, from examples as diverse as the Barcelona Pavilion and the Ping Pong experiment. It occurs at the site of flatness. The planar or surface qualities of flatness provide continuity to these conditions, making interventions on the flat material more gradual and therefore ambiguous.

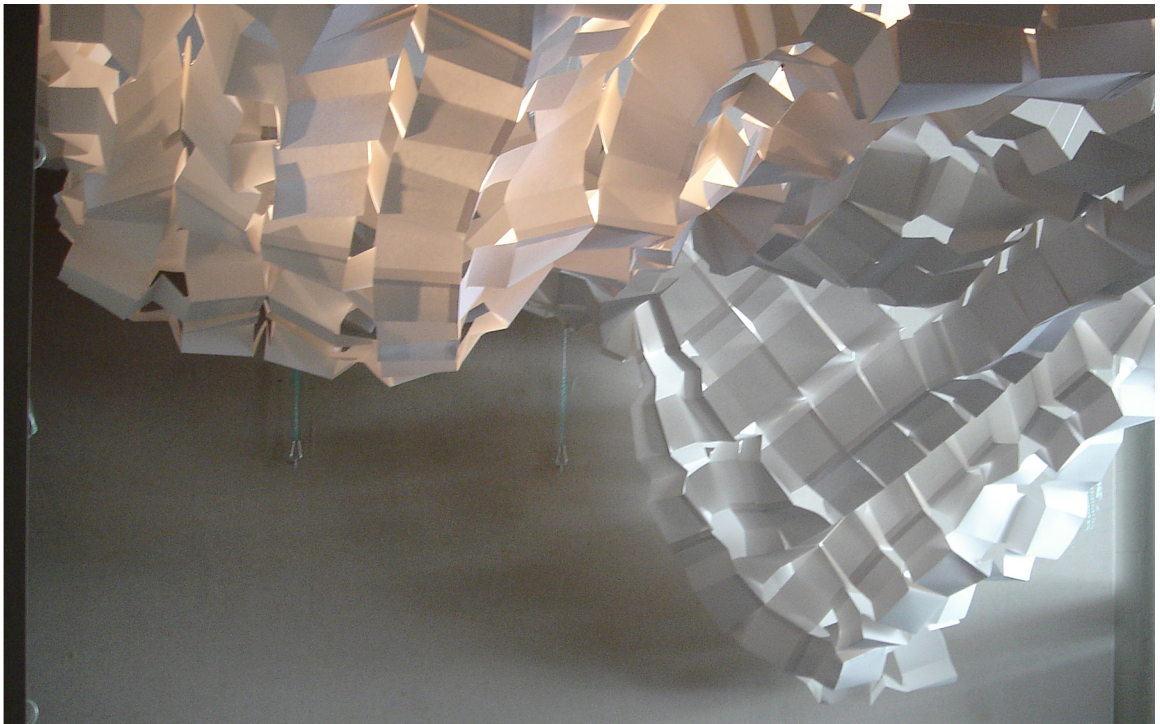
The installation is different from the experiments and taxonomy because its purpose is to draw together the attributes of flatness rather than isolate and examine a particular trait. Therefore, it is an exercise in expansion and contraction, and a manipulation of these to create a specific spatial condition.

Installation Description:

The large-scale architectural installation is made of cut and folded paper which is capable of expanding and contracting while suspended from an operable hoisting system. The paper is cut in a regular pattern to accommodate folds running perpendicular to one another. The folds produce smaller units which are designed to allow the paper to bend in multiple directions to make complex shapes as shown below. The diagram shows a single piece of paper, cut and folded in the manner described. Each page measures 2' by 3', and the installation is composed of 72 pieces.



Multiple folded units like the ones shown above are glued together into a larger matrix, and attached to control points which are grouped into nine operable bundles. These bundles each have two resting points: one higher, one lower. They are held up by pulleys and controlled by carabiners, each of which can attach to one of two hooks mounted on the surrounding walls.



The installation is between four and six feet off the ground, and it fills the site, which is an area of approximately ten by fifteen feet. The site is bordered by two walls, a third wall with a large window and clear door, and a partition on the opposite side. It is the front section of a small gallery. The scale is meant to be large enough to create an architectural condition so that the body can experience the installation's flatness along with seeing it.

Interaction is an important element of the installation. It enables the observer to both observe expansion and contraction and to control it. Though pulling the hoists causes somewhat chaotic conditions, it is possible to imagine the approximate effects of lifting or lowering the sections. The raising or lowering action has the added feature of sending the viewer information about the static forces acting on the installation. If one pulls a section higher than the sections surrounding it, the material seems to become heavier because it begins to lift the edges of the sections around it. If that section is lower than those around it, the same thing will happen in reverse, as the moving section will start to be supported by the areas surrounding it.

It is an interactive piece both because of its operable parts and because it is possible to lower the installation below eye or shoulder level, requiring one to lean over to walk or stand below. It compresses the space, and this compression affects the body. At a lowered state, it causes one to stoop down. The body must bend and twist to look up, such that although the object is closer, it's more inconvenient to look at. When raised, the installation can be seen just by looking up. Lifting it makes the space below expand.

The built product was a more complex spatial condition than intended or expected. The units that comprise it were simply designed to be drawn together or flattened out, expanding and contracting along perpendicular axes. However, the size of the site could only really accommodate the installation's scale while

the latter was mostly contracted. This was partly because a scale model built in advance behaved quite differently from the modules that were built at full scale. They were larger, heavier, and their flexibility and rigidity appeared in different ways. Forces acting upon the scale model and final installation behaved quite differently. What appeared to be the right number of modules for the intended effect turned out quite differently at full scale.

This difference in behavior of materials was exaggerated by limitations set by the hoisting system as well. The pulleys were attached to a grid of track lighting, consisting of squares approximately five feet apart. The placement of the pulleys and the design of the rest of the hoist system made for mostly vertical motion. Without lateral pulling forces, the installation could not expand to flatten the modules as intended. Lateral control points were omitted because they would have further complicated forces acting on the object, possibly causing it to break.

Examining the mechanism used in this installation and the manner in which it caused the materials behave is one useful approach to discuss possibilities of flatness in the realm of architecture. Specifically, the design of the object created an interesting relationship between continuity and ambiguity. This relationship arose from the initial intent, which was to create a condition of expansion and contraction.

First consider an ordinary piece of paper. It has two opposing faces that have clear boundaries. The paper's surfaces are continuous, and there is little ambiguity about the material's components, its behavior, and how it relates to the surrounding space.

The paper used for the installation was cut. This created gaps in the middle of the pages and around the edges, decreasing the paper's continuity. The holes and complex edges interrupt the simple rectangular page. Similarly, the folds in

the page caused breaks in continuity on the page. Originally, the paper's surfaces were flat planes. Once folded, the two flat surfaces were broken into smaller, intersecting flat planes.

The holes and folds allowed a greater range of motion in the paper. Usually, if one bends a piece of paper, the bend can only occur along a single axis. Any second bend would cause a crease. However, this holds true for each individual plane in the installation, where 'plane' is devised as any area of paper bound by a cuts and folds. This means that the matrix of modules has a tolerance for more complex curves. The curves are formed by pulling modules in a particular direction, but they are also enabled by the forgiving, flexible quality of the paper. In other words, a wood or cardboard version would behave more rigidly, and probably would not allow compressed modules to twist in the same way.

Just as the continuity of the installation was decreased, its ambiguity increased. The presence of multiple holes and folds turned a planar material into one which contorted into numerous directions. The ease with which these directions could be manipulated made the boundaries and faces of the pages more ambiguous. The mutability of parts also made it possible to make any particular zone of the installation stretched out and therefore partly transparent, or compressed and opaque. The inverse relationship of ambiguity and continuity is one that could be quite useful to consider in architectural design, as it has many possible applications.



Chapter Five: Final Reflections

The dictionary definition of 'flat' describes it as a condition where space is missing. This is implied by the inclusion of words like 'depth' and 'height.' The definition also describes what something flat may be missing in various contexts. By using negative terms such as 'without' and 'lacking' flatness by extension seems negative. Even in vernacular or slang uses it implies something bad, such as a person seeming impassive, or champagne missing its effervescence. Describing writing as 'flat' means it is uninteresting.

The negative connotations easily spill into architecture. Architecture students who have trouble envisioning spatial relationships are told their work is flat, and to 'think three-dimensionally.' It is good advice. However, the architect cannot and should not avoid flatness altogether. The challenge is not to abandon the flat in lieu of the spatial. It is to reconcile the two as symbiotic in design.

Chapter One of this document explained as an example that a piece of paper can be used to succinctly describe three-dimensional ideas, and that its flatness is what allows architects to resolve and share their ideas. It was also stated that flatness is something that exists only when observed by the senses. However, the exercises which followed revealed that there are many kinds of flatness, and that 'flat' is not a static condition, but one that is often created or altered to a particular end. Both these statements must be repositioned considering the taxonomical and phenomenological findings.

Flatness and space are intrinsic to one another, and they exist together to varying degrees. The drawing on the page is flat, and used to imagine space. However, an object in space creates a similar condition. In both cases the observer sees only the outermost layer of matter, and in both cases observation of that surface is used to extrapolate what exists within but cannot be seen. In

the former case, one could say that the flatness of the paper is dominant and that space, only a suggestion created by lines and shading, is recessive. The latter exists in space, and the mind's extrapolation of visual information using surfaces causes the mind to believe it is seeing space, when in fact it sees light bouncing off an infinitesimally small proportion of the matter that surrounds it - merely the boundaries of volume and void. Space is perceived as dominant, and flatness recedes.

Somewhere in amidst those two extremes, architects have managed to produce a whole range of conditions somewhere in between. This is because space and flat interact in drawings before the design is even developed. The grayscale has been further filled in by a growing diversity of media. In particular, digital drawing technology has enabled architects to not only show space in new ways, but more importantly to design and conceive space in different ways. Three-dimensional flybys, calculus-based computer modeling, diagramming, and building information modeling (BIM) are among these. They bridge the divide between drawn and built, between flatness and real space. Along the gradations between them, one begins to see the ambiguity and continuity of flatness in a new light.

Ambiguity and continuity are certainly the qualities of flatness which make for interesting flat conditions in space. This is because they arise from the mutation of flatness, in which an intervention is performed (perhaps in drawing, perhaps directly on an object) where a design either originates or terminates at flatness. A number of the taxonomical precedents discussed reflected this. In particular, the Holocaust Memorial, the Yokohama Port Terminal, the Strasbourg Hoenheim Tram Terminal, the Wrapped Reichstag, the Dom-ino House, and the Visible Human Project all used or implied flatness as an original condition in their designs.

To shift the flat from a static state to a mutable one, one must observe interventions of flatness. Therefore, although 'flat' and related terms like 'surface' and 'plane' help describe the specifics of flatness, the attributes of 'flattening' and 'unflattening' are more revealing because they expose the behavior of flatness. 'Flatten' and 'unflatten' are also required to discover the limits of flatness: when it emerges, and when it disappears.

The taxonomy and experiments repeatedly mentioned various verbs that described flatness interventions. Layering, affiliation, convolution, thickening, and flattening were all found to have in common expansion and contraction - forces that coexist when altering a flat thing. This pairing is at the center of any change to flatness. The fact that they occur simultaneously indicatives the ambiguity which can arise. As is shown in the Crumple experiment, it's possible to make something smaller in one way and simultaneously larger in the other. The result is usually a zone or zones in which the boundaries of the flat thing is unclear. This idea was found as interstitial space in the taxonomy, and experiments such as Crumple, Bend in Half, Ping Pong, and Slice Part Two, each of which altered the interior and exterior of the objects used.

Direction

In **New Flatness**, Alicia Imperiale discusses the shrinking gap between design and production, specifically citing parametric design methods, in which a three-dimensional computer model can be adjusted to individualized specifications, and used to program the manufacture of objects.²⁵ The findings of this body of work align with that general concept. Digital technology already affects the aesthetics and construction of design. However, this is part of a more broad trend which, as discussed, brings the represented and the built closer and closer. It is seen not only in computer modeling, but in hand-drawn designs such as

²⁵ Imperiale, p60.

Daniel Libeskind's Jewish Museum, which used hand-drawing. It is also reflected in projects such as the Chanel Store in Tokyo, where the represented becomes a skin for the built, in that case using a large video screen.

These changes in design are rooted in how space is perceived. The Visible Human Project (VHP) is a germane example of this because of the type of data it is built upon, and the way it is represented. The difference between how the body is portrayed by MRIs and thinly sliced is a considerable leap from Dr. Carter's drawings in Gray's Anatomy. The VHP's version of the body is one of which every fraction of an inch can be known by way of MRI data. Any point inside the body is equally accessible, whereas in early anatomical drawings it was separated into systems, cut away in layers. This new high level of accessibility emulates motion, whereas the drawings were static and partial.

MRIs, three-dimensional computer modeling, and the digital screen are small components of a larger trend in how space is understood and depicted. As scientific ideas about space change, architecture and its technologies will be affected. Flatness will always be an entry point to understanding these ideas, and will simultaneously be affected by them, as we have only begun to see in hypersurfaces and topological surfaces in architecture.

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